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ABSTRACT

A three-phase investigation of memory and metacognitive development was conducted to learn how teachers structure children's study activities to develop memory and metacognitive skills. In the first study, observations of 69 teachers of kindergarten through sixth grade classes showed a peak in strategy suggestions at the second and third grades. Factor analysis showed that use of cognitive strategy suggestions by teachers is a unique aspect of instruction. Teachers showed awareness of developmental change and differences related to achievement level in their expectations for children's memory strategy use, memory knowledge, and use of memory monitoring abilities. The second study compared children whose teachers were either high or low in frequency of cognitive strategy suggestions. Strategy use and metacognitive concepts of first through third grade children were assessed in a memory training task and in arithmetic and spelling tasks. Average and low achievers whose teachers were high in strategy suggestions showed strong maintenance of a trained memory strategy. Few differences related to teacher characteristics appeared on other tasks. The third aspect of the project was a workshop for elementary school teachers, in which information on memory and metacognitive development and memory training was presented, along with many examples of ways in which teachers can facilitate children's memory. (Author/RH)

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FINAL REPORT

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Abstract

A three-phase investigation of memory and metacognitive development in the elementary school years was carried out, in order to learn how the teacher structures study activities so as to further the child's development of memory and metacognitive skills. In the first study, observations of 69 teachers of grades K through 6 showed a peak in strategy suggestions at the second and third grades. A factor analysis of observational data showed that the use of cognitive strategy suggestions by teachers is a unique factor that characterizes a distinct aspect of instruction. Teachers showed awareness of developmental change and a strong view of differences related to achievement level in their expectations for children's memory strategy use, memory knowledge, and use of memory monitoring abilities. The second study compared children from classrooms in which teachers were either high or low in frequency of cognitive strategy suggestions in the classroom. Strategy use and metacognitive concepts of first through third grade children were assessed in a memory training task and in arithmetic and spelling tasks. Average and low achievers whose teachers were high in strategy suggestions showed strong maintenance of a trained memory strategy. Few differences related to teacher characteristics appeared on other tasks. The third aspect of the project was a workshop for elementary school teachers, in which information on memory and metacognitive development and memory training was presented, along with many examples of ways in which teachers can facilitate children's memory in the classroom.

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Chapter 1. Introduction

Researchers, applied psychologists, and educators have agreed in recent years that there is a need for increased communication between individuals carrying out research on the development of children's information-processing skills and those concerned with assessment and remediation of children's learning difficulties in educational settings (Hagen, 1982; Moely, Leal, & Crays, 1982; Siegler, 1982). Researchers in the field of education have also begun to focus on information-processing skills of learners (Snow, 1976; Wang, 1980) and have begun discussions of how teachers may facilitate such skills (Winne & Marx, 1977). In particular, there appears to be an increasing awareness of the importance of memory as an aspect of cognition that is crucial for intellectual accomplishment (Bromage & Mayer, 1981; Mullally, 1977; Wittrock, 1979), and an interest in applying research findings on memory development and memory strategy use to classroom activities (Corno, 1980; Higbee, 1979; Wittrock, 1978).

Curriculum materials are designed to provide a structure within which classroom learning can take place, and have traditionally been the focus of efforts to regulate the course of cognitive acquisitions. However, we are becoming increasingly aware of the importance of the strategies the child uses to understand (Dee-Lucas & DiVesta, 1980; DiVesta, Hayward, & Orlando, 1979; Kail, Chi, Ingram, & Danner, 1977; Markman, 1977, 1979), retain for retrieval (Flavell, 1970; Hagen & Stanovich, 1977; Moely, 1977; Pressley, 1982), and manipulate (DeCorte & Verschaffel, 1981; Siegler, 1982) information, and of the extent to which children will differ as a function of developmental level in their ability to engage in these activities. Research on the development of memory and on the child's use of strategies in acquiring and retaining information suggests important developmental changes in skills, which appear across a variety of tasks and situations (Brown & DeLoache, 1978; Brown, Bransford, Ferrara, & Campione, 1983; Flavell, 1979). Flavell (1970) and others have shown that at certain ages and on certain tasks, children will suffer from a "production deficiency" in the use of their information gathering and retrieval processes. Especially during the early elementary school years, the child may possess the capacity to engage in a particular behavior or to apply some specific knowledge in a memory task, but for reasons that inhere in the task or the child, he or she does not demonstrate this capacity or knowledge in situations in which it would be appropriate to do so.

Interest in mapping the range of situations in which production deficiencies would appear and in determining how easily such problems could be overcome led, through the 1970's, to a good deal of research that trained children to use effective strategies to encode and retrieve information. Training manipulations were developed for the most part with

traditional memory tasks such as serial recall, in which cumulative (verbal) rehearsal of items appears to aid short-term retention (Belmont & Butterfield, 1977; Flavell, 1970; Hagen, 1982; Hagen & Stanovich, 1977), free recall of verbal materials that can be organized on the basis of meaning (Lange, 1978; Moely, 1977; Moely & Jeffrey, 1974; Moely, Olson, Halwes, & Flavell, 1969), and paired associates learning, in which unrelated concepts or pictures can be associated in thought through the use of verbal or imaged mediators (Pressley, Heisel, McCormick, & Nakamura, 1982). Although such training efforts did often produce strategy use and concomitant improvements in recall performance by young children on the training task, they rarely produced lasting changes in the child's approach to that task. Further, they also failed to provide learning techniques that the child could generalize to new tasks and situations (Brown & Campione, 1977; Hagen, Hargrave, & Ross, 1973; Keeney, Cannizzo, & Flavell, 1967; Scribner & Cole, 1972).

The failure of early training studies to produce lasting or transferable strategy use led investigators to examine the development of metacognitive skills in children. The first work in this area was concerned with describing the development of the child's metamemory, defined as his or her knowledge of memory processes, strategies, and factors affecting memory (Kreutzer, Leonard, & Flavell, 1975; Flavell & Wellman, 1977). Research showed that, with age, children become more planful in their approach to memory problems, more knowledgeable about ways of dealing with memory tasks, and more aware of their own strengths and weaknesses as learners. Kreutzer, et al. (1975) found that even kindergarten and first grade children possess certain basic kinds of information about memory. They know, for example, that the number of items to be learned and the time available for study will affect task difficulty, that savings will be experienced in relearning something, and that information in memory will be lost over time. But not until about the third grade do children understand that relations between items can be used to aid their recall, that interference can affect retention of information, that recall requirements will influence the way in which one ought to study, and that it is important to prepare ahead of time so as not to forget an important event. Even by fifth grade, not all children understand these more complex aspects of memory, suggesting continued development of metamemorial knowledge throughout and beyond the elementary school years.

Another aspect of metacognition has to do with the relationship drawn by the learner between his or her metamemory concepts and task performance. Flavell (1979) described " metacognitive experiences" as those events in which the child attempts to regulate actively his or her learning efforts on the basis of knowledge about memory processes and situational factors. Thus, for example, we might ask how the child generates study plans and selects from

among them the one that will aid study in a particular task. Or, does the child use feedback about his or her performance to decide whether or how to modify study activities? Is the child aware of characteristics of a task in which a given strategy will be useful, and can he or she apply the strategy in all situations for which it will aid learning? Is the child able to judge that he or she knows something well enough to stop studying? Can the child identify items that need to be studied, and give them more intensive learning efforts than are given to items already known? Is the child able to adapt study techniques to fit the nature of the recall task that will be given? Developmental improvement in the child's ability to apply knowledge about memory to the regulation of his or her own study activity occurs during the elementary school years, for a wide variety of learning situations (Appel, Cooper, McCarrell, Sims-Knight, Yussen, & Flavell, 1972; Masur, McIntyre, & Flavell, 1973).

Concern with metacognitive processes like these has led to creative new training efforts to improve memory task performance by training metacognitive skills. There is interest in training the child not simply in the rote application of a strategy, but in teaching strategies together with explanations of why and how such behaviors are useful, with the hope that training outcomes will be more stable and broadly applied than was the case in previous work. One approach has been to increase the child's understanding of the value of a strategy by giving feedback concerning its influence on amount recalled (Black & Rollins, 1982; Kennedy & Miller, 1976; Kramer & Engle, 1981; Paris, Newman, & McVey, 1982; Ringel & Springer, 1980). Other training studies have focused on strategies with the potential for wide application as a way of increasing generalization to new tasks (Brown, Campione, & Barclay, 1979; Leal, Crays, & Moely, in press). Usually these more recent studies have shown more stable and lasting effects of training, and effects that appear across a wider range of generalization tasks than was true of earlier training studies (Asarnow & Meichenbaum, 1979; Belmont, Butterfield, & Ferretti, 1982; Brown, et al., 1983).

Pressley, Borkowski, & O'Sullivan (1984) describe a series of experiments that used several different kinds of procedures to encourage the acquisition of metacognitive knowledge. They found that adults will often show increases in metacognitive knowledge simply as a result of practice with a task, but children, even 11 to 12 year olds, usually need a much more deliberate and directed intervention. When children are taught strategies along with detailed knowledge about how and when the strategy can be used, what its effect should be, and for what tasks the strategy is appropriate or inappropriate, Pressley and his colleagues find that the strategy is used and generalized optimally to new tasks. Thus, intensive training at the metacognitive as well as at the strategy level is effective in promoting the use of facilitative learning techniques.

Another approach to training that derives from current interests in metacognition is described by Pressley, et al. (1984) as consisting of training in "metamemory acquisition procedures," which are defined as "techniques applied to cognitive strategies for the purpose of acquiring additional information about those strategies" (p. 102). Thus, an effort is made to teach children procedures that they can use to acquire metacognitive knowledge for themselves. In a study with second graders, for example, Lodico, Ghatala, Levin, Pressley, and Bell (1983) trained 7- and 8-year-olds to evaluate performance when various strategies were used to complete a task. After this instruction, which attempted to teach the children that tasks can be done in a variety of ways that are not all equally useful, and that a learner should select the strategy that is best for the task at hand, the children were taught several memory strategies. Those who were first trained to evaluate the usefulness of different learning activities were better able than controls to select a useful strategy, give up a useless strategy, carry out strategy application during study, and subsequently, then, carry out an adequate recall.

Although memory training efforts are becoming potentially more useful to school learning situations, efforts thus far to directly apply findings to the classroom have been limited. There are only a few lines of work that have investigated the usefulness of training procedures in the classroom. There is research in the area of "cognitive behavioral modification" (Meichenbaum & Asarnow, 1979), which uses a self-instructional training program developed by Meichenbaum (Meichenbaum & Goodman, 1971) as a way of modifying a child's approach to a cognitive styles test. In cognitive behavior modification, the child is taught to direct, monitor, evaluate, and reward his or her own problem-solving or study behaviors. Meichenbaum and Asarnow (1979) describe research in which this procedure or related teaching methods have been used successfully with children from kindergarten through 8th grade, as they deal with a variety of academic tasks in the classroom. The authors note, however, that these training efforts have not shown as much generalization of study behaviors to new tasks as one would like to see. They propose new directions for training that are similar to those currently being used in the area of memory, with emphasis on feedback and the training of more general skills or executive routines that will have direct applicability across a wide range of task situations. Peterson and Swing (1983) have also considered the difficulties involved in applying cognitive behavioral modification procedures in classrooms. They urge increased efforts toward involvement of teachers directly in the training process, something that has rarely been attempted in the past.

A second line of research that has been used in classroom applications is the "keyword" method, which derives directly

from research on paired associate learning (Pressley, 1982; Pressley, et al., 1982). The keyword method encourages the child to use verbal or imagery mediators to form associates between concepts and key words chosen to represent items such as foreign language words, proper names, or technical terms that are to be learned. Although early efforts to apply the keyword method in the classroom were disappointing, there have been several recent reports of successful use of training to improve 5th and 8th grade students' learning of foreign language vocabulary (Pressley, et al., 1982), 8th graders learning of surnames paired with events, facts, or accomplishments (Jones & Hall, 1982; Shiberg, Levin, McCormick, & Pressley, 1982), and 8th graders' learning of definitions of technical terms (Jones & Hall, 1982). How training procedures will be elaborated to yield positive effects across a wider range of ages and tasks remains to be seen.

Thus, it has been demonstrated that memory and metacognitive skills show important developmental changes over the elementary school years, and that it is possible to create training procedures to facilitate such development. At the present time, little is known about factors in the child's environment that contribute to the development of memory and and metacognitive skills. If one assumes that developmental change is influenced by the same kinds of procedures that have been shown to be important in laboratory experiments, then it seems reasonable to look to the school as a setting for the exercise, instruction, regulation, and refinement of memory and metacognition. At the time the present work was proposed, little was known about how study behaviors, including the use of mnemonic and self-regulatory activities, are typically encouraged by teachers in elementary school classrooms, how teachers themselves view the development of children's memory and the use of strategies in learning, and how these phenomena vary across grade level. The first aspect of the present project was to find out about how teachers structure and regulate memory and metamemory activity in the elementary school classroom. This initial study employed classroom observations, interviews, and questionnaires with teachers of grades K through 6, in order to learn about teacher characteristics, behaviors, attitudes, and beliefs about memory processes and their development. This study is summarized in Chapter 2, below.

As a result of the first study, we were able to identify several classrooms in which teachers used many cognitive and strategy suggestions and other classrooms in which such suggestions were rarely given. In order to learn how differences in the teacher's emphasis on strategy use in memory affected the children's task performance, a study was carried out with children selected from first, second, and third grade classes that were either high or low in teacher strategy suggestions. Performance on individually-administered recall, spelling, and arithmetic tasks was

assessed. Chapter 3 summarizes the method and findings of this study.

The third phase of the project involved the development of materials for use in inservice training for practicing teachers and as part of teacher-training courses in colleges and universities. Materials were designed to help the teacher acquire increased knowledge about memory processes and their development and increased awareness of the role that he or she could play in facilitating children's use of their memory skills in completing classroom tasks. By using information from the first two studies, together with information from the research literature, a workshop was prepared and carried out with several groups of elementary school teachers. A description of the development of the workshop and an evaluation of its usefulness by teachers is presented in Chapter 4, below. A narrative of the workshop is given in Chapter 5.

In conclusion, the project was concerned with determining the ways in which teachers influence children's memory and metacognition in the classroom, and using this information in conjunction with knowledge derived from previous research to produce materials to help teachers and teachers-in-training learn how to encourage age-appropriate development of children's memory and metacognitive skills. The chapters below describe our efforts toward achieving these goals.

Chapter 2. Teachers' Regulation of Memory Efforts in the Classroom

The present study was designed to address two separate concerns about memory development in the classroom. First, from the perspective of developmental psychology, the question of how memory activity is encouraged in the classroom is of interest as one potential influence on the development of memory, and metacognitive skills. Over the elementary school years, children become increasingly adept at planning and executing appropriate memory strategies and also become more aware of their own memory processes. We know very little about factors in the child's environment that contribute to these developmental changes, but might well assume that the school plays an important role in stimulating and instructing memory skills and metacognitive knowledge. A description of how teachers encourage memory activity and how they view their students' memory skills is a first step in understanding the school's role in this development. Secondly, from the perspective of educational research, it is of interest to describe the ways in which elementary school teachers attempt to encourage study strategy use and metacognitive activity, to determine the extent of variation in tendencies to do so, and to describe how such efforts may vary across the elementary grades.

Classroom observations, an interview, and a questionnaire were used in this study to learn about how teachers of children in grades K through 6 encourage memory strategy use and effective study in the classroom, and to obtain information on teachers' views of children's memory abilities and limitations.

Teachers' Classroom Behaviors: Observations

Method

Subjects. A group of 69 teachers from grades K through 6 participated in the research. For analysis, they were divided into an early elementary group (consisting of 8 kindergarten and 9 first grade teachers), a middle elementary group (consisting of 11 second grade and 13 third grade teachers, and a later elementary group (consisting of 11 fourth grade, 13 fifth grade, and 4 sixth grade teachers). All of the teachers were working in the public schools of the New Orleans area, with approximately one-third from the urban center of the city and two-thirds from suburban areas nearby. Approximately one-third of the teachers were black, the rest were white. All but 3 were female. Sixty-five of the teachers gave us information on their backgrounds (Table 1), indicating that they had spent an average of 8.44 years teaching the grade at which they were seen working this year, and that they had spent an average of 14.89 years in the teaching profession.

Table 1

Means (and Standard Deviations, in Parentheses) for Years of Teaching Experience and Time Since Taking College Courses, for Teachers at Early, Middle, and Later Grade Levels

Grade Level	Total Teaching Experience	Years Experience in Grade	Years Since College
K-1	13.47	9.76	11.33
	(7.34)	(7.98)	(8.76)
	(n = 17)*	(n = 17)	(n = 15)
2-3	14.36	7.91	11.00
	(7.39)	(7.30)	(8.61)
	(n = 22)	(n = 22)	(n = 22)
4-5-6	16.27	8.00	11.60
	(8.96)	(6.47)	(10.03)
	(n = 26)	(n = 25)	(n = 25)

* n varies according to the number of questionnaire respondents for each item.

An average of 11.32 years had elapsed since their last attending college classes. Over half of the sample reported age as between 31 and 40 years. Approximately 58% of the group had a Bachelor's degree, while 42% had pursued graduate training. No differences as a function of grade level taught were shown for any of these indices.

Observational Instrument. A classroom observation instrument (Table 2) was developed to give information about how the teacher structures classroom activities for children, how the teacher engages in learning activities with children, and how he or she monitors and directs children's study, including suggestions for memory and study strategies. The main guidelines in developing the observation scale were to develop a scale that adequately represented activities that occur when a teacher is structuring a lesson in the classroom and, at the same time, to produce a scale that could be used reliably. A time-sampling procedure was developed, in which observers watched the teacher interact with children during classroom lessons and recorded aspects of the teacher's behavior. We found that 30-second intervals were easy to use and informative in recording many classroom situations: The first 20 seconds of each interval was used for observing, while the remaining 10-second period was used to record the events that occurred during that interval. As a result of pilot work, observers found that 30 consecutive minutes of observation time gave a realistic picture of teacher activities. Observers learned to use the observational scheme in scoring classroom activities as they participated in the development of the scale. When the final form of the scale was ready, pairs of observers scored videotapes of teachers and also did pilot work in classrooms to establish a criterion of at least 75% reliability. Actual reliability achieved prior to data collection was 88% overall agreement. Throughout the course of data collection, periodic checks on reliability were made to ensure continued accuracy in the scoring of classroom activities. These checks indicated overall percent agreement of 87% throughout the observation period.

The final observational scoring form used for each classroom observation consisted of four pages. The first two pages were used for scoring 30 consecutive minutes of classroom activity. (An example of one of these pages is given in Figure 1.) Structuring of learning activities is shown in the teacher's statements of goals or objectives of the lesson ("Today we're going to learn about homonyms"), in placing the lesson in the context of work done previously ("Now we're going to use what we learned in addition to help us in subtraction"), and in describing procedures for doing the work. Interactions between the teacher and learner were examined in terms of both the teacher as a source of information and the teacher as a director of the children's active learning efforts. For example, a teacher could present factual or episodic information ("A homonym is a word that

Table 2.

Definitions of Categories Used in Classroom Observations

Reviews previous work: One way to indicate what a lesson will be about and what its goals and objectives are is to relate it to work done previously. The teacher might actually review previous work, or may simply refer to it. This can also be useful as a reminder of procedures or task content.

Examples:

"Before, we've talked about word problems that only involved two operations -- addition and subtraction. Today we're gong to add a third operation that we've been using for awhile and this is, multiplication."

"Now we're going to use what we learned in addition to help us in subtraction."

States goals; objectives: Teacher provides an overview of the task or lesson, emphasizing the topic of the work, the goal of the activity. This activity may be carried out by the teacher, or the teacher may engage in some activity to induce a child to produce this information or assist her in doing so. The information may be produced by the individual or may be read from a text or workbook. Such statements may occur at the beginning, during or at the end of a lesson.

Examples:

"Today we're going to talk about word problems."

"Now what we want to do today is to go over what you do when you see a word problem -- how you figure out what to do next and how you go through the whole process."

Describes procedures: The teacher describes procedures for doing the work. This information is task-relevant, having to do with "how to" rather than task content or goals. It does not include comments related to discipline, but does include giving directions concerning the task.

Examples:

"What I want to do is read a problem to you and let's go through each one of the steps."

"Turn to page 49 in your Gateways workbook."

"We're going to decide who goes first by rolling the die and whoever gets the highest number of dots goes first."

Presents specific information: Teacher presents factual or episodic information. Teacher may, for example, read a word or sentence, spell a word, name something, define a term, give a fact, or tell about an event. This category includes information given in the context of posing a problem for the

Table 2, continued

class or individual: reading a math problem, for example.
Examples:

"Matthew gave David a $10.00 bill." (reading part of a math problem).

"A homonym is a word that sounds just exactly like another word, but it's spelled differently and it means something else."

States principles: Teacher presents information about universals, abstractions, laws, theories, generalized concepts of ideas related to the content of the lesson.
Examples:

"Multiplication is simply repeated addition."

"When you multiply a number by one, the answer is always still the same number."

Describes processes: Unlike the two categories above, this kind of information is not concerned with the content of the lesson, but rather with ways and means of dealing with the task. It includes the teacher's explanation of cognitive processes to be gone through in solving a problem or producing the correct answer. Whereas "procedures" focuses on the task and what has to be done according to the rules of the task, this category focuses on the learner and what activities the learner has to engage in while performing the task.
This behavior is assumed to have occurred when the teacher describes a strategy. In that case, one would score "processes" while also indicating the strategy suggested or suppressed or the rationale for a strategy at the bottom of the observation scale.
Examples:

"The first step is to figure out what facts you have; the second step is to decide what facts you need."

"When you look at a problem, what you have to figure out is will it be quicker for you to multiply than it would be to add."

"If you're not quite sure, read the problem again."

Requests child's inquiry: The teacher invites children to seek clarification of information that has already been presented. Such comments can occur within the context of presenting information on goals, procedures, or task content.
Examples:

"Does anybody have any questions about the problems or how to do them?"

Table 2, continued

"OK, Derek, what's your question?"

Asks memory question: Child is expected to recall, remember, recognize something that has been presented or learned previously. Either the material has been considered earlier in the lesson observed, or teacher refers to previous learning of the material, or it consists of information that children can safely be assumed to have memorized and therefore would not need to engage in complex cognitive processing to produce.
Examples:

"What's something else we know?" (asking recall of facts in a math problem).

"12 X 5. Now we don't have to work that out, do we, because we're supposed to know that -- Megan?"

Asks convergent question: Child is expected to engage in some cognitive processing of information present in situation in order to come up with a "correct" answer that teacher has in mind. Implication is that there is only one, or maybe two correct answers -- not an opportunity for the child to be creative. The cognitive operations involved could be simple ones of perception or directing attention, or can be more complex operations such as comparing, contrasting, synthesizing, relating, organizing, defining, analyzing, etc. The teacher may be asking the child to recite or read material or write it on the blackboard.
Examples:

"How much did she spend at the store?" (Child has to subtract to get answer).

"If we're trading by 4's, how many yellows would you have to have to get a green?" (Not just a memory question -- child has to work from yellow to blue to green, across three place values, to get answer).

"I'll bet someone in this room can guess what's on this card."

"Mary, read the next one."

Asks divergent question: Child is expected to engage in some cognitive processing of information or stimuli present in the situation in order to come up with one or more of a number of possible ideas, associations, or implications of which no single one could be predetermined as uniquely right or correct. Question is phrased so as to put child "on his/her own" to range broadly and freely in thinking and responding.
Examples:

(Teacher starting to write a story with child): "Esther,

Table 2, continued

what's your idea today?"

"Make up a sentence to show that you know what this word means."

"Can you give me an example?"

Asks evaluative question: Questions here deal with matters of value rather than matters of fact. Child is expected to reply with a judgment of such aspects as desirability, worth, acceptability, or correctness.

Examples:

"OK? Is that neater now?" (Child is writing letters).

"OK, is that right? Is that how much change Matthew had, Class?"

Acknowledges correct response: Teacher indicates matter-of-factly that the child has answered correctly. This category is scored whenever "praise" is also scored in response to a correct answer. This category may be assumed to occur when the teacher simply continues with the lesson, or calls on the next person, without indicating that the child has made an error.

Examples:

"Yes -- she spent 65 cents at the store." (repeating child's response.)

"That's OK."

Praises child: Teacher produces a supportive behavior which exceeds a simple designation of correctness and rewards students for their performance. Praise is usually defined as an expression of approval, esteem, or commendation. Teacher expresses enthusiasm or pleasure with the child's response.

Examples:

"That's great! Super!"

"OK, that's very good!"

"You're right! Terrific!"

Criticizes child: Teacher produces a harsh, punitive, blamelaying, guilt-inducing reaction to the child's response.

Examples:

"Two times five is 10, and we can write it here."

"No, that's wrong. Didn't you study this at all?"

Table 2, continued

"I'm tired of your talking out of turn, Pete. You take this to Mr. Jones (principal)."

Indicates child's error: Teacher indicates matter-of-factly that child has answered incorrectly. This category should be scored when teacher criticizes (or praises) error, and also when any of the next three categories is scored in response to an error.

Tells correct answer: After the child responds, the teacher simply says the correct answer.

Examples:

"A good sentence using this word would be `Their cat is named Fuzzy.'"

Gives hint, rephrases: Upon hearing the child's incorrect response, the teacher does something to help the child get the correct answer. What he or she does might involve repharasing the question or giving the child some hint or prompt for the answer. This statement does not have to be directed to the same child who made the error; it could be directed to the group or to another child. It culminates in a request for a response from the child or children.

Examples:

"Don't do that column first. Start over here. What's this?"

"Wait a second. We haven't gotten to the operation. We still have another fact that's really important. What is it, Mary?"

Explains error: The teacher tells child why his or her answer was incorrect. This involves a factual statement, in which the teacher does not request the child "try again" or produce another response.

Examples:

"Billy, I'm erasing some of your lower case letters because I think that you forgot that you have to go up to the yellow line after you get to 2 o'clock."

"Ooops -- that (answer) was made using the first word, not the second one that I asked you about."

Monitors study activity: Children are engaged in individual study of some material. Teacher may walk around and look over kids' shoulders, or simply look at children's work, if they are seated near her/him. Need to have some evidence that teacher is actually attending to children's task-related work, not just watching them for disciplinary reasons.

Table 2, continued

Warns/instructs memory: Teacher simply states his/her expectation that the child is to remember some material, implying that study should be done, but not specifying the nature of study or strategy use at all.

Examples:

"I expect you to learn these for the test on Friday."

"I want you to remember this set of numbers."

Strategy suppressed: Rarely, but importantly, teachers will urge children not to use strategies: "Don't count on your fingers", etc. The strategy that was discouraged by the teacher should be described in the space at the bottom of the chart and also written up in narrative form in the appropriate space on the observation sheet. Add your best judgment in narrative as to whether suppression was appropriate or not. In writing about the strategy, be sure to indicate 1) the nature of the lesson in which the potential use of the strategy occurred; 2) what the teacher said or did to discourage use of the strategy; 3) what the strategy was; 4) how many children appeared to be using it; 5) any rationale the teacher made for not using the strategy; and 6) any followup instructions the teacher made later in the lesson to remind children not to use the strategy.

Examples:

" (Child says that he is taking notes): "You don't need to do that right now."

"I don't want to see anyone counting on their fingers."

Rationale/feedback for strategy use. Teacher, while telling child to use a strategy, makes clear that it will serve a memory/learning function for the child.

Examples:

"Write down the facts I tell you, so that you can remember them later."

"This number ladder will help you get the right answer."

Strategy suggested: The teacher suggests a strategy that would be appropriate for the task verbally, or demonstrates it in some way. The strategy that is encouraged by the teacher should be described in the space at the bottom of the chart (briefly) and then written up in narrative form on the third page of the observation sheet.

In writing about the strategy, be sure to indicate 1) the nature of the lesson in which the strategy was to be used; 2) what the strategy was supposed to accomplish; 3) what the teacher said or did to introduce the strategy: how (s)he

Table 2, continued

described or demonstrated it, what (s)he drew on the board, etc.: 4) rationale the teacher gave for using the strategy; 5) any followup the teacher made to remind the children to use the strategy, later on during the lesson.

SUMMARIES:

At the end of each day, write a short paragraph summarizing your impressions of each observation. Indicate any things that the interviewer might need to know in order to clarify the teacher's approach during the interview. Indicate your impressions of the classroom atmosphere, the teacher's approach and attitude, the behavior of the children, etc.

At the end of the total set of five observations, write a summary concerning the variety of activities and behaviors seen over the sessions. Be sure to indicate any questions of which the interviewer should be aware.

Activities: 1) new 2) practice 3) review 4) quiz 5) seatwork 6) song 7) other

Classroom _____ School _____ Observer(s) _____

Class Topic _____ Time: From _____ to _____ Date _____ Grade/Level(s) _____

INTERVAL	0	0:30	1	1:30	2	2:30	3	3:30	4	4:30	5	5:30	6	6:30	7	7:30	8	8:30	9	9:30	10	10:30	11	11:30	12	12:30	13	13:30	14	14:30
Activity:																														
Specifying Structure of Lesson																														
Previous work: Refer to, review																														
Presents goals/objectives																														
Presents procedures																														
Teacher Initiates Interaction																														
Presents information: Specific																														
Presents information: Principles																														
Presents information: "Processes"																														
Requests child's inquiry																														
Requests task-related answer: Memory																														
Requests task-related answer: Trans: Converg.																														
Requests task-related answer: Trans: Diverg.																														
Requests task-related answer: Evaluate																														
Teacher Responds to Correct Answer																														
Acknowledges correct response																														
Elaborates task-related comment																														
Teacher Gives Evaluation																														
Praise																														
Criticism																														
Teacher Responds to Error																														
Indicates child has made error																														
Tells child correct answer																														
Gives hint, rephrases question																														
Analyzes, explains error																														
Study Behaviors Encouraged																														
Teacher monitors study activity																														
Teacher warns, instructs memory																														
Strategy suppressed																														
Rationale/feedback for strat use																														
Strategy suggested																														

Figure 1. Coding Sheet Used in Observing Teachers' Behaviors

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sounds just exactly like another word, but it is spelled differently and it means something else"), provide information about generalized principles or concepts ("You know every word has to have a vowel"), or specify the kinds of mental operations or processes that children should follow in performing the task ("When you look at a problem, what you have to figure out is will it be quicker for you to multiply than it would be to add"). The teacher also could invite children to seek clarification of information already presented ("Does anybody have any questions about the problems or how to do them?"). We also recorded the use of questions by teachers during the course of a lesson and how teachers responded to answers to their questions recorded under "teacher responds to correct answer", "teacher gives evaluation", and "teacher responds to error."

An important aspect of the observational scale was concerned with how the teacher encourages study behaviors in children's classroom work, including the teacher's instructing or attempting to suppress strategies that children may use to aid memory or to regulate their individual study. Teachers' monitoring of children's individual study, helping children to anticipate memory tasks ("I expect you to remember these for the test on Friday"), discouraging the use of certain strategies ("I don't want to see anyone counting on their fingers"), giving a rationale for or feedback concerning strategy effectiveness ("Write down the facts I tell you, so that you can remember them later"), and encouragment of strategy use ("When you are through, reread your answers and make sure you are correct") were examined.

An initial problem in assessing the teacher's encouragment of study behavior involved a definition of "strategy suggestion" that would be workable in the open, uncontrolled environment of the classroom. Most memory strategy work has been done in laboratory settings, in which it is possible to specify ahead of time the nature of strategies that will be examined. Common strategies that have been observed in laboratory tasks are verbal rehearsal (Hagen, 1982), organization of items (Moely, 1977), elaborative processing (Pressley, 1982), self-testing, looking, and naming (Leal, et al., in press). In order to operationalize the definition of a strategy, we considered two aspects that have often been discussed in the literature (Flavell, 1970; Pressley, et al., 1982). First, the activity the teacher suggested had to be a voluntary one that children could employ in doing the task, but that was not simply an automatic accompaniment of task involvement. Thus, circling the correct answer with a pencil was not a strategy, since that was a necessary component of task performance. On the other hand, keeping one's pencil on an item as a marker to indicate which item the class was discussing would be considered a strategy, since it is a voluntary and an "extra" thing that the child could do to aid performance. The second aspect of the definition of a strategy was that the activity must be goal-

directed, especially directed toward a goal of learning or remembering information or understanding or completing a task. Generally, then, the strategy suggestion had to be made in the context of a learning activity, rather than a social or classroom management activity, and within that context, the strategy suggested had to be one that might reasonably be assumed to facilitate learning, on the basis of our understanding of the research literature. Observers were highly reliable in coding strategy suggestions, showing essentially perfect agreement in recording instances of such suggestions, for assessments of agreement made either prior to data collection or in periodic checks throughout the observation period. Thus, although our definition of "strategy" was very general, it was adequate in allowing observers to reliably recognize strategy suggestions.

The third page of each observation form was used for detailed hand-written explanations of strategies that the teacher suggested to children or attempted to suppress during the observation period. Some of these instances occurred outside of the 20-s observation intervals used for recording teacher behaviors. Observers were instructed to write descriptions of these as well as of strategy-related suggestions made during the time-sampling intervals. Also, teachers sometimes repeated the same strategy suggestion or attempted repeatedly to suppress some strategic activity during several different 10-s intervals within a 30-minute observation period. When this occurred, the observer was instructed to write a single event description, indicating the intervals within which it occurred. Thus, the data obtained from these event descriptions are similar to, but not isomorphic with data obtained from the time-sampling observational scheme. Strategies observed during classroom observations were subsequently categorized from their written descriptions. The final page of each observation form was used by observers to write a short paragraph summarizing their impressions of each observation and describing any special circumstances under which observations took place.

Interview. In order to learn more about classroom activities that the teacher used to aid memory development and memory activity, each teacher participated in an interview of approximately 40 minutes. The interview was conducted in an open-ended fashion, and teachers were asked about tasks involving memory and how they attempted to help children deal with them. Teachers were encouraged to talk about activities and strategies that they found to be useful in aiding children's learning, activities they suggested that children do "on their own" or with parents' help, and strategies that they did not find to be useful. The emphasis was on gaining information about what teachers have found through their own experience to be helpful in facilitating children's memory performance. The interview questions are shown in Table 3. The teacher was first asked to generate an example of a task in which children were expected to engage in memory activity.

Table 3

Questions Used in Teacher Interviews

General Memory in the Classroom.
What kinds of memory tasks are required of children in your classroom?
(Select one task and ask the following questions.)
Are your children, in general, successful for their grade level on this task?
Are your children expected to study or learn this material on their own?
Think about your 5 highest achieving students, how do you think they study for this task?
Think about your 5 children with the greatest learning needs on this task, how do they study?
What kinds of study strategies, if any, do you suggest to your children?
Do you monitor children's study activities on this task or do they study independently?
If you monitor study activitiy, how do you decide when they have studied enough?
If they study independently, how do the children decide when they have studied enough?
What have you found to be useful in motivating your students to study?
Do the children in your classroom report that they do or do not know something and are they accurate in their reports?

Spelling. I would like you to describe a typical spelling lesson by answering the following questions.
How many spelling words are children expected to learn per lesson?
How do you decide which words will be included in each lesson?
On what day of the week are the students first exposed to the words
In what way are the words introduced?
Throughout the week, what other activities do the students carryout with these words? How well do each of these activities work?
Are the students expected to study on their own?
Think about your 5 best spellers, how do you think they study?
Think about your 5 children with the greatest learning needs in spelling, how do you think they study their spelling words?
Do you have any children who seem to have particular difficulty with spelling? What do you think their problems are?
What do you think they could do to improve their spelling ability?
What types of activities do you suggest to parents to help their children prepare for their spelling test?
When is the spelling test given? How is the test given?
Immediately before the test, do you give the children any specific instructions about thes test itself or engage in any spelling-related activities?
What happens if a child misses word(s) on the test?

Math. What new math skills are emphasized at your grade level? (Pick one factual knowledge skill and one procedural knowledge skill and ask the following.)
What kinds of classroom activities do you use to introduce this information and to promote learning of this information?
What kinds of materials have you found to be helpful?
How well do each of these activities work?
Are students expected to study these facts on their own?
How do you think your 5 highest achieving students in math memorize or study the material they need to learn?
Think about your 5 children with the greatest learning needs in math, how do you think they memorize the information they need to learn?
Do you have any children who seem to have particular difficulty with learning this math fact? What do you think their problems are?
What do you suggest to parents to help their children learn math facts?
What kinds of activities do you use to promote children's learning of the proper sequence of steps? How well do these activities work?
Do you ever try to get parents to help children with this learning? How?
Do you think children make more errors in math because they do not follow the proper sequence of steps necessary to solve the problem or because they have not memorized certain facts they need to know?
Which do you think are harder for your children to learn, math facts or the procedures necessary to solve math problems?

General Questions.
In general, how do you feel about the children you are teaching this year?
How do they compare with children you've taught in previous years?
Are the children you teach this year doing as well academically as you would expect them to, or better, or less well? Why do you think that is?
What do you see as areas in which your children have the most difficulties?
What do you see as their areas of greatest strength?

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The interviewer asked a series of questions aimed at gaining a picture of how children of higher and lower ability in the teacher's classroom typically approached this memory activity. The teacher was asked about the kinds of study strategies used and how successful each was. Similar questions were then asked for three particular areas of study that seem to require memory: spelling, the learning of mathematical facts (addition, subtraction, multiplication facts, etc.), and the learning of mathematical procedures (regrouping in addition, steps in long division, etc.). The teachers often suggested effective strategies that children could use in their individual study efforts. Information obtained from the interviews was used extensively in development of the workshop materials (Chapter 5).

Results

Teachers' Use of the Behavioral Categories. Table 4 shows the means and standard deviations derived from observational data for each of the behavioral categories. As indicated there, teachers engage in a great deal of convergent questioning, give extensive feedback about correct answers, convey a great deal of specific information, and spend a good deal of time describing procedures for doing lessons. Less frequently, the teacher indicates errors the child has made, describes cognitive processes to be used in carryng out a lesson, asks memory questions, monitors study behavior, and praises the child. Very rare occurrences involve the teacher's use of criticism, attempts to suppress strategies or to give a rationale for strategy use, and statements of general principles. It should be noted that on the average, teachers gave strategy suggestions during only 2.28% of the intervals in which they were observed. In fact, 7 of the 69 teachers (10%) gave no strategy instructions at all during the time that the observers were in the classrooms. Rationales for strategy use were rarely given, indicating that both strategy and metacognitive instruction are relatively infrequent occurrences in the elementary school classroom.

Factor Analysis of Observational Data. In order to examine the relationships between the various observational categories, a factor analysis was carried out on data from all 69 research participants, employing a principal components solution with varimax rotation. As indicated in Table 5, four factors included a total of 21 of the observation categories. These accounted for 49% of the variance in scores. Of particular interest for our work is the clear grouping in Factor 2 (Cognitive Processes and Strategies) of the several observational categories dealing with the teachers' suggestions to the child about how to study. Teachers who suggested strategies for studying and remembering were also likely to offer a rationale for strategy use, to frequently provide information about appropriate cognitive processes for task performance, and also were likely to tell children NOT to engage in certain study strategies. In addition, these

Table 4

Means and Standard Deviations for Observation Categories. Each Score Representing the Percentage of 300 Intervals in Which Teacher Behavior Was Scored (n = 69 Teachers)

Variable	Mean	Standard Deviation
Reviews Previous Work	2.86	1.44
States Goals, Objectives	1.61	1.17
Describes Procedures	27.10	8.96
Presents Specific Information	26.06	10.25
States Principles	.41	.65
Describes Processes	9.51	5.95
Requests Child's Question	.86	.99
Asks Memory Question	7.17	4.93
Asks Convergent Question	32.30	11.64
Asks Divergent Question	3.59	3.26
Asks Evaluative Question	1.93	2.50
Acknowledges Correct Response	27.84	10.74
Praises Child	8.51	7.18
Criticizes Child	.07	.31
Indicates Child's Error	11.00	5.27
Tells Correct Answer	3.12	2.84
Gives Hint, Rephrases	3.72	2.29
Explains Error	1.36	1.45
Monitors Study Activity	8.03	7.40
Warns Memory	.83	1.36
Strategy Suppressed	.10	.35
Rationale for Strategy Use	.43	.74
Strategy Suggested	2.28	2.65

Table 5.

Factors Derived from Observational Scale Used in Classrooms of 69 Teachers of Grades Kindergarten through Six

Factor 1. Interactive Teaching

Teacher asks a memory question, in which child is to recall, remember, or recognize something that has been presented or learned previously. (Factor loading = .64)

Teacher asks a convergent question, requesting child to produce a correct answer on the basis of cognitive processing of information given. (Factor loading = .76)

Teacher asks a divergent question, requesting child to engage in cognitive processing of information given so as to come up with one or more of a number of possible ideas, associations, or implications of which no single one could be predetermined to be uniquely correct. (Factor loading = .48)

Teacher asks an evaluative question, requesting child to make a judgment concerning desirability, worth, acceptibility, or correctness, rather than to produce a factual answer. (Factor loading = .34)

Teacher acknowledges a correct response that the child has made in the lesson. (Factor loading = .83)

Teacher praises the child's efforts to carry out lesson-related activities. (Factor loading = .65)

Factor 2. Cognitive Processes and Strategies

Teacher suggests the use of a strategy in carrying out a memory or learning task. (Factor loading = .80)

Teacher gives a rationale for the use of a strategy, indicating that it will serve a memory/learning function for the child. (Factor loading = .85)

Teacher attempts to suppress the child's use of a strategy, by telling the child not to use it. (Factor loading = .42)

Teacher gives information about cognitive processes that the child can use in dealing effectively with a learning task. (Factor loading = .75)

Teacher requests the child's inquiry about information that has been presented. The teacher invites the children to seek clarification of information on goals, procedures, or task content. (Factor loading = .58)

Factor 3. Teacher Responses to Errors

Teacher indicates that the child has made an error in written or spoken response. (Factor loading = .92)

Teacher tells the child a correct answer, subsequent to the occurrence of an error. (Factor loading = .73)

Teacher gives child a hint or rephrases a question, subsequent to error. (Factor loading = .77)

Teacher explains child's error, telling child why an answer was incorrect. (Factor loading = .30)

Factor 4. Communicating Task-Related Information

Teacher refers to or reviews a previous lesson as a way of introducing a new topic. (Factor loading = .67)

Teacher presents the goals and objectives of the lesson. (Factor loading = .63)

Teacher presents specific information: factual or episodic material relevant to the lesson. (Factor loading = .66)

Teacher presents information about principles: abstractions, laws, theories, or generalized concepts related to the content of the lesson. (Factor loading = .31)

Teacher instructs the child to remember something, without giving any suggestions about cognitive processes or methods of study. (Factor loading = .55)

(Negative loading) Teacher monitors child's study, without engaging in any interaction with the child. Teacher is attentive to child's individual study efforts, but is not actively directing or assisting in the work. (Factor loading = -.63)

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teachers were likely to ask children to tell them about their questions or problems with learning tasks. The tendency to engage in these cognitive processing suggestions is relatively independent of several other groups of activities that teachers demonstrated in the classroom. Factor 1, which we have called Interactive Teaching, involved the use of questions and positive feedback during lessons. Questions range from requests for memorized information and factual material to requests for novel but appropriate answers and for the child's personal evaluation of some aspect of the lesson. Feedback associated with interactive teaching is generally positive in providing information about the child's performance or in the affect shown toward the child. Another cluster of items (Factor 3: Teacher Responds to Error) concerned the teachers' reactions to the child's error, involving feedback about the error as well as several activities subsequent to error, which included telling the child the correct answer, giving a hint or encouraging the child to try again, or analyzing the child's error in order to show him or her the nature of the mistake made. A final cluster (Factor 4: Communicating Task-Related Information) involves communication of information from the teacher to the child in a rather traditional teaching mode, whereby the teacher sets the lesson in a context of previous work and states goals or objectives, provides both specific information and principles of the lesson, and finally, warns the child of the need to remember this information (without suggesting how this is to be done). The tendency to monitor children's individual work is negatively loaded on this factor, which generally seems to reflect the teacher's high level of activity in providing information to the child during lessons.

In summary, classroom observations indicated that teachers do instruct children in the use of strategies and give feedback about how strategies can affect performance, but such activities do not occur with high frequency. The tendency to focus on cognitive processes in a number of different ways, by giving information about how to process information, suggesting or suppressing strategies, indicating why strategies should be used, and asking children to voice their difficulties with a task are activities that cluster together. Some teachers will use most or all of these, while other teachers do not engage in them.

Relationships of Grade Level and Subject Matter to Teacher Behaviors. Analyses were carried out to determine if there were grade differences in the use of the observational categories by teachers, and to assess the influence of the subject matter of instruction on teacher behaviors. The subject matter designations were determined by examining the topic of instruction for each of the five observations made for each teacher. For 28 teachers (5 at grades K-1, 10 at grades 2-3, and 13 at grades 4-6), all five observations were made during the teaching of language arts. In addition, a fourth grade teacher who taught social studies was grouped

with the language arts teachers, since her interactions with children were concerned primarily with reading and retaining information, yielding a total of 29 teachers classified as teaching language arts. For 40 teachers, instruction included either mathematics only (2 teachers at K-1, and 2 at grades 4-6) or mixed activities in both mathematics and language arts (10 teachers at grades K-1, 14 teachers at grades 2-3, and 12 teachers at grades 4-6). The teachers who were observed while teaching only mathematics or mathematics plus language arts were classified as having "mixed" classroom activities, and were grouped for comparison in analyses below.

An initial analysis was made to investigate grade level or subject matter differences in the use of the entire set of categories. This analysis showed that there were no overall differences in the number of behaviors scored as a function of either grade level or subject matter. In considering how teachers varied over grade level or by subject matter, then, findings can not be attributed to simply a greater amount of activity shown in general for a particular grade level or subject. The various behavioral categories were used with widely varying frequency by the teachers and usage varied as a function of grade level. These conclusions are based on the findings of an analysis of variance involving grade (3 levels) and subject matter (language arts, mixed) as between-subjects variables and behavioral category (23 levels) as a within-subjects variable. The analysis yielded significant effects of category, $F(22, 1386) = 236.10$, $p = .000$, reflecting the differences shown above in Table 4, and a significant interaction of grade level with category, $F(44, 1386) = 2.42$, $p = .000$, indicating that the use of categories is distributed differently across grade levels.

To explore further this grade difference in category use, analyses were made of measures representing the four factors that had been identified earlier in analysis of the observational data. Factor scores were obtained for each individual by summing the specific categories involved in each factor described in Table 5, and dividing that sum by the number of categories involved in the factor (in order to allow comparisons across factors involving different numbers of categories). We can conclude from this analysis that the several factors are used with varying frequency and that factor use varies with grade level. The analysis involved grade and subject matter as between-subjects variables and factor as a within-subjects variable. Significant effects were factor, $F(3, 189) = 185.24$, $p = .000$, and grade level by factor, $F(6, 189) = 2.43$, $p = .027$. Mean scores for each factor are shown in Table 6, where it can be seen that on Factor 1, Interactive Teaching, and on Factor 3, Teacher Responds to Error, there are tendencies for a decrease over grade level, while Factor 4, Communicating Task-Related Information, tends to increase over grade level. Factor 2, Cognitive Processes and Strategies, peaks at the 2nd-3rd grade level.

Table 6

Mean Scores for Categories Involved in Each Factor by Teachers at Three Grade Levels

Category	Grade Level K-1 (n = 17)	2-3 (n = 24)	4-5-6 (n =28)
Factor 1. Interactive Teaching			
Acknowledges correct response	32.9	27.9	24.8
Asks convergent question	35.4	33.1	29.8
Praises child	14.4	8.0	5.3
Asks memory question	7.8	6.9	7.0
Asks divergent question	2.5	3.8	4.0
Asks evaluative question	1.2	2.6	1.8
OVERALL SCORE: FACTOR 1	15.70	13.72	12.12
Factor 2. Cognitive Processes and Strategies			
Rationale for strategy	.4	.6	.4
Strategy suggested	2.1	3.1	1.6
Describes processes	8.3	10.2	9.7
Requests child's question	.6	.8	1.1
Strategy suppressed	.2	.1	.1
OVERALL SCORE: FACTOR 2	2.31	2.95	2.56
Factor 3. Teacher Responses to Errors			
Indicates child's error	10.9	11.5	10.7
Gives hint, rephrases	4.6	3.4	3.5
Tells correct answer	2.7	4.0	2.6
Explains error	1.5	1.5	1.2
OVERALL SCORE: FACTOR 3	4.93	5.07	4.49

Table 6, continued

Factor 4. Communicating Task-Related Information			
Reviews previous work	2.5	2.9	3.1
Gives specific information	22.0	25.7	28.9
States goals, objectives	1.8	1.4	1.7
Warns memory	.5	.8	1.1
States principles	.4	.6	.3
Monitors study activity	9.5	6.9	8.1
OVERALL SCORE: FACTOR 4	6.09	6.37	7.18

To further explore grade differences in category use, each factor was considered in a separate analysis. Each of these analyses involved grade level and subject matter as between-subjects variables and category as a within-subjects variable. When significant interactions involving category occurred, these were explicated by applying Anovas involving grade level and subject matter to each of the individual categories involved in the factor under consideration.

For categories involved in Factor 1. Interactive Teaching, the analysis indicated differences in the frequency with which categories were used, $F(5, 315) = 302.90$, $p = .000$, which appears to reflect the high frequency with which teachers used convergent questions and acknowledged correct responses of children. There is also a significant interaction of grade level with category, $F(10, 315) = 2.34$, $p = .011$, which reflects a significant decrease over grade level in the use of "praise," $F(2, 63) = 8.07$, $p = .001$, with lesser grade differences for the other measures.

Teachers' use of the categories involved in Factor 2. Cognitive Processes and Strategies, varied according to the subject matter taught, $F(1, 63) = 5.60$, $p = .021$, with higher use of suggestions for cognitive processes and strategies occurring when the subject matter included mathematics ($M = 3.07$) than when it involved only language arts ($M = 2.03$). Category use varied significantly, $F(4, 252) = 126.03$, $p = .000$, as indicated in Table 6, with descriptions of processes made more often than any of the other activities included in this factor. There was also an interaction of subject matter by category, $F(4, 252) = 5.98$, $p = .000$, which reflects the difference between language arts and mixed activity classrooms in the teacher's tendency to make suggestions regarding appropriate cognitive processes. Mean scores for suggestions regarding processes were 7.31 for language arts and 11.10 for mixed subject matter observations, $F(1, 63) = 7.13$, $p = .01$. It appears that instruction which includes mathematics is more likely to involve teacher suggestions about how to think through or manipulate information than is instruction in language arts. None of the other categories showed differences as a function of subject matter.

Factor 3. Teacher Responses to Errors, showed differences among categories, $F(3, 289) = 163.78$, $p = .000$, as shown in Table 6. This appears to reflect high use of indications by the teacher that the child has made an error, rather than to differences in subsequent activities that a teacher might show following such an indication.

Factor 4. Communicating Task-Related Information, showed a significant category difference, $F(5, 315) = 197.71$, $p = .000$, reflecting frequent use of the category, "Gives specific information." A significant grade level by category interaction, $F(10, 315) = 2.88$, $p = .002$, is due to an increase with grade level in the use of the specific

information category, $F(2, 63) = 3.54$, $p = .035$. None of the other categories in Factor 4 showed a change over grade level.

Finally, the category, "procedures," which does not load on any factor, also showed a grade level difference in a simple analysis of variance, $F(2, 63) = 4.21$, $p = .019$, with higher scores obtained at lower grades (mean for grades K-1 = 32.5; for grades 2-3, $M = 26.3$; and for grades 4-6, $M = 24.5$).

To summarize, only a few grade differences appeared in the ways that teachers used the categories. With increasing grade, teachers were less likely to praise children, more likely to spend time conveying specific information, and less likely to spend time presenting procedures by which tasks are to be done. Categories involved in a factor concerned with teachers' suggestions for cognitive processes and strategies did not vary significantly over grade level, although the mean scores shown in Table 6 indicate higher use of strategy suggestions and information concerning cognitive processes at the intermediate grades (Grades 2 and 3) than at either earlier or later grades. Subject matter area had its influence primarily on the measures included in the cognitive processes factor, with instruction that included mathematics involving more suggestions regarding cognitive processes than did instruction in the language arts area. Processes, the most-used category in this factor, was particularly sensitive to such subject-matter differences, reflecting teachers' frequent use of suggestions about how to carry out problems and complete work as they presented lessons in mathematics.

A Micro-analysis of Strategy Suggestions. Analyses above have described the use of strategy suggestions by teachers in a global fashion, summing data across five separate observations. Another question that can be addressed with these data concerns the nature of the classroom situation that exists at the moment the teacher makes a strategy suggestion. For example, it is possible that a teacher might mention a strategy while introducing a classroom task and presenting procedures for its completion, or on the other hand, might react to observed difficulties children are having with a task by suggesting a strategy. Although our observational scheme focused on teachers' behaviors, it was possible to use it to derive a limited picture of the classroom at the time a strategy suggestion was made by examining the other teacher behaviors that were likely to occur in proximity to a strategy suggestion. Thus, for instance, frequent co-occurrence with strategy suggestions of behaviors in Factor 3, Teacher Responds to Errors, would suggest that children needed help in mastering an ongoing task, while high use of Factor 4 behaviors in conjunction with strategy suggestions might suggest that the teacher is actively introducing a lesson to the class at the time a strategy is mentioned.

In attempting to identify the correlates of teachers' strategy suggestions, we examined data for only the first

occurrence of a strategy suggestion made during any 30-minute observation period. Thus, a teachers' data could be coded for anywhere from 0 to 5 strategy suggestions. We considered only the first occurrence of a strategy suggestion in an observation period in order to avoid carry-over effects from one strategy suggestion to another. A teacher might repeat a strategy suggestion subsequently not on the basis of what was transpiring in the classroom, but as an extension of the suggestion already made. The 20-s observation interval within which the strategy suggestion was made was examined together with the 20-s observation interval immediately preceding it, so that inferences could be made about events in the classroom immediately prior to and during the time that the teacher gave a strategy suggestion. This procedure meant that we considered activities that occurred during a time span of 40 seconds (two 20-s intervals, divided by a 10-s recording interval), which seemed to be a reasonable amount of time in which to identify the immediate classroom situation. This was an arbitrary decision; certainly, an argument can be made for examining a longer time interval.

In order to evaluate the nature of activities co-occurring with strategy suggestions, it was necessary to have some baseline that represented the nature of activities that would be expected to occur in the classroom during the 30-minute observation period. Comparison points of two kinds were identified: first, a completely random selection of another 20-s interval was made from the same 30-minute observation period, and second, a random selection was made of a 20-s interval in which the category, "Gives specific information" had been coded. For these two comparison time periods, as for the strategy time period, data were combined across the 20-s interval and the interval that immediately preceded it. Thus, teachers' activities over two 20-s observation intervals were summed in each of three types of time period: a strategy suggestion interval, a randomly chosen comparison interval, and a specific information comparison interval. The selection of the specific information category as the basis for selecting a comparison interval was made in order that we might be sure of having a comparison point in which the teacher was actively involved with students, although in a very different way than in the strategy suggestion interval. "Gives specific information" was chosen as the comparison activity because it occurs frequently, thus offering the possibility of finding a codable comparison interval in each observation, and because it is unrelated both statistically and conceptually to the category involving strategy suggestions.

The sample consisted of 61 teachers (16 at Grades K-1, 24 at Grades 2-3, and 21 at Grades 4-6). Eight teachers who gave no strategy suggestions within time-sampling intervals were excluded from consideration. Teachers were further grouped within each grade level according to whether they were high (four or more total strategies suggested; n = 31) or low (n =

30) in total strategy suggestions observed.

Analyses involving grade level and high-low strategy teacher as between subjects variables and interval (strategy, random comparison, specific information comparison) as a within subjects variable were carried out on factor scores and also on data for each observational category. An analysis of data from the four factors was made (excluding from sums the observational categories of "strategy suggested," "gives specific information," and also excluding those instances of the category, "describes processes" that were scored in conjunction with the scoring of a strategy suggestion). This analysis showed only that more activities of all kinds occurred during observation intervals in which the teacher suggested strategies (M = .15) than in random comparison intervals (M = .11), while intervals in which specific information was given showed an intermediate degree of teacher activity (M = .13), $F(2, 110) = 4.12$, $p = .019$. Thus, when they gave initial strategy suggestions during an observation period, teachers also tended to be carrying out other coded activities from several of the factors constituting the observational scale. Next, separate analyses were made of behaviors involved in each of the factors. These analyses showed that there were no differences between the three kinds of interval for the use of behaviors in Factor 1 (Interactive Teaching), Factor 3 (Teacher Responds to Errors), or Factor 4 (Communicating Task-related Information). On the basis of these analyses, then, we were unable to show relationships between teachers' description of strategies as part of task-related information given in introducing or carrying out a classroom task, or between teachers' acknowledgement of children's errors in a task and strategy suggestions.

Analyses of measures constituting Factor 2 showed differences between intervals for several measures. First, there were more suggestions about suppression of a strategy during strategy suggestion intervals (M = .04) than there were in randomly chosen comparison intervals (M = .07) or in specific information comparison intervals (M = .03), $F(2, 110) = 3.74$, $p = .027$. Second, the category, "Rationale, feedback for strategy use," occurred in the strategy suggestion intervals, as might be expected, but not in either of the two kinds of comparison interval. More interesting was an interaction of Grade Level x Interval for this measure, which reflected an increasing tendency across grade for the teacher to accompany an initial strategy suggestion with a rationale for the use of that strategy, $F(4, 110) = 3.60$, $p = .008$. Rationales were given less often at Grades K-1 (M = .11) than at Grades 2-3 (M = .22), and occurred most often at Grades 4 through 6 (M = .39). With increasing grade level, then, teachers were more likely to give children a rationale for the use of strategies in their work, a finding that suggests particular sensitivity of teachers to the cognitive abilities of the students they teach.

In general, this analysis of teacher behaviors co-occurring with initial strategy suggestions seen during an observation period showed primarily that several behaviors closely related to strategy suggestions are likely to occur in conjunction with such suggestions: teachers are likely to attempt to suppress certain strategies while they are encouraging others, and, especially at higher grades, teachers are likely to accompany strategy suggestions with a rationale for strategy use. Apart from these findings, the outcomes for this analysis were somewhat disappointing in failing to identify other teacher behaviors that occur in conjunction with strategy suggestions. An observational scheme that includes detailed observations of students' as well as teachers' activities might be more useful than the present scheme in identifying conditions that prompt the use of strategy suggestions by teachers.

Categorizing Strategy Suggestions Made by Teachers. As part of the observational procedure, in-class observers identified instances in which teachers suggested or attempted to suppress cognitive strategy use by children. Observers were trained to identify as a strategy any voluntary, goal-directed activity that teachers described during an observational interval. For each of these occurrences, the observer wrote a brief narrative, noting the time interval and the general situational context in which the teacher's suggestion was made. The following description of how these observations were summarized into a category scheme is taken from Hart (1984), in work conducted for her Honor's thesis.

A categorization scheme was established initially by means of a review of the memory strategy literature and by examination of the nature of the suggestions made by teachers. Operational definitions for each of the categories were constructed on a tentative basis, after which four raters attempted to group the 326 strategies into the categories of this original scheme. Classification of an item was assumed to be accomplished successfully when three of the four raters agreed to a particular categorization. Following this preliminary work, the category definitions were revised to fit more closely the content of the strategies observed. When the raters agreed that a given description contained instructions that fit into more than one category, the description was divided into two or more parts, as necessary, so that separate instructions within the description could be categorized. Items were then classified a second time by the same four raters, with the criterion for adequate classification again set as agreement by three of the four. Nineteen of the 326 items were eliminated from consideration when raters agreed that they represented simple procedural, non-strategic instructions. Of the 307 items remaining, raters agreed unanimously or in 3 of 4 cases on 265, leaving a set of 42 items for which agreement was not obtained. These items were subsequently assigned to categories through group discussions in which the raters achieved a consensus

concerning appropriate classification. Two independent raters, who were not involved in the development of the category scheme, were given the final definitions and descriptions of the categories (below), and used them to classify the 307 items. The first rater agreed with the classification made by the original group in 82% of the cases, while the second rater agreed for 78% of the descriptions. These two raters agreed with each other in categorizing the items 74% of the time. Thus, the categorization scheme is one that can be applied reliably to event descriptions of category suggestions.

The Categorization Scheme. Of the total set of 307 items categorized as strategies, 292 were instances of strategy suggestions made by teachers and 15 were instances in which the teacher attempted to suppress the use of a strategy by a child. Twelve categories were used to classify the strategies described. These are defined as follows:

1. Rote Learning

> Rote learning strategies are instructed for simple repetitive learning. Children are told to rehearse stimuli verbally, or to write, look at, go over, study, or repeat them in some other way. The children may be instructed to rehearse items just once, a finite number of times, or an unlimited number of times. Rote learning strategies do not include any explicit activities that would add meaning to the stimulus, or cause it to be processed to a deeper level or in terms of more extensive associative relationships.

Teachers typically instructed children to "practice," "go over" material, or "study," "look at," "read," write," or "say" spelling words or multiplication tables n-times. Strategies of this type were suggested a total of 30 times by teachers in all grades except kindergarten, most frequently (8 times each) in grades 3 and 4.

2.) Elaboration

> The elaboration strategy is instructed for use with stimulus materials that generally do not have much intrinsic meaning to children, such as the definition or pronunciation of words, etc. Children are instructed to
>
> use elements of the stimulus material and assign meaning by, for instance, making up a phrase or sentence, making an analogy, or drawing a relationship based on specific characteristics found in the stimulus material.

Teachers instructing this strategy suggested, for example, to kindergarten children that they could outline the shape of a word, then associate the shape with the meaning of the word and thus be better able to remember it. Other

typical examples from this category were suggestions by teachers to remember numbers, words, or signs on the basis of some characteristic intrinsic to it. For instance, to remember what the letter "b" looks like, children can remember that it looks like a bat and a ball, and the bat always comes before the ball; one teacher suggested that the homonyms "meat" and "meet" could be differentiated by remembering that "meat" had the word "eat" in it and one eats meat. This kind of strategy was suggested a total of 25 times by teachers, most frequently in grades 2 and 3 (6 times each).

3.) Attention

Attention strategies are suggested by teachers to direct or maintain children's attention to a task. For example, teachers may instruct children to "follow along" or "listen carefully" during lessons.

Teachers suggesting this strategy would typically instruct children to "follow along" or "listen carefully," or to "think" before they attempted to do a task. Teachers often specified what words children should look for in a task, or in which order certain steps had to be executed. Attentional strategies were suggested 35 times by teachers in grades K through 5, most frequently (16 times) in grade 2.

4.) Specific Attentional Aids

This strategy is similar to the attention strategy, but children are instructed to use objects, language, or a part of their body in a specific way to maintain orientation to a task. Although these aids are employed in a specific way for the attentional task, they may have other uses.

The specific attentional aids teachers suggested included such things as paper markers to follow along when reading, using fingers to point or follow along, or putting the hand at the throat to feel the formation of sounds. Teachers suggested such aids 23 times. However, there were also three instances at second and third grade levels in which teachers suppressed finger pointing as an attentional aid or prohibited children from "moving their lips" or "mumbling" when reading.

5.) Transformation

Transformation is a strategy suggested by teachers for transforming unfamiliar or difficult problems into familiar or simpler ones that can then be solved more easily. Transformations are possible because of logical, rule-governed relationships between stimulus elements. Teachers identify these relationships and tell children either that a problem can be rewritten, or that it can be reformulated if the method of solution is

related or derived from rules and procedures learned previously. Due to the emphasis on logical, rule-governed relationships, this strategy is usually suggested in mathematics.

Teachers suggesting this strategy usually instructed children to rewrite subtraction problems as addition problems, or rewrite problems written horizontally in a vertical form. Teachers also suggested that children could check results from division problems by multiplying, or that they should factor and cancel before trying to solve problems involving fractions. Teachers in grades 1 through 5 suggested this type of strategy 20 times, most frequently in second, third, and fourth grades (5 times each). One third grade teacher suppressed this strategy by instructing children not to use subsets in solving a problem.

6. Deduction

In deduction, children are instructed to use their general knowledge, in combination with any clue from the material that seems helpful, to deduce and construct the correct answer. Teachers might direct children to use contextual information (e.g. pictures accompanying a text, or parts of the text), or to analyze the item into smaller units (e.g. looking for root words, analyzing words phonetically).

Teachers who suggested this strategy told their students to use the story content or pictures to figure out answers to questions about a story, or to use the meaning of a sentence to figure out what a new vocabulary word in it meant. Teachers also told children to "sound out" vocabulary words, or to figure out what a story was about by reading the title, and skimming over words. This type of strategy was suggested 33 times by teachers of all observed grade levels, most frequently in second (8 times) and third (7 times) grades.

7.) Exclusion

This is a strategy to help children answer test or workbook questions even if they don't know the correct answer initially. Children are told to eliminate incorrect options systematically, either by (1) doing the problems they know first, then trying to match questions and answers that are left over; or by (2) trying out all possibilities and selecting the one that seems correct.

Typical examples of this strategy were to try out all sounds in a word to decide if a vowel was long or short. Or, to systematically eliminate possibilities for punctuation in a sentence (i.e., question mark, period, or exclamation mark) by asking questions about the sentence (i.e., is it an asking sentence, is it a telling sentence, does the sentence convey

excitement). This type of strategy was suggested only 9 times, most often in first and fourth grades (3 times each).

8.) Imagery

This strategy usually consists of non-specific instructions to remember items by taking a mental picture of them, or to maintain or manipulate them in the mind. It also refers to visualizing procedures or characters.

Teachers suggesting this strategy typically told children to "picture" a puppet that they were going to make in their minds, or to keep a picture of geometric figures in their minds so they could see them when they were doing geometry. Teachers suggested this type of strategy 11 times, most frequently (5 times) in second grade.

9.) Specific Aids for Problem-Solving and Memorizing

This strategy involves the use of specific aids in problem solving or memorizing. Even though these aids may have other uses, the teacher instructs one specific application of them. Teachers may give explicit instructions on how to use the aids in the task at hand. Thus, children are instructed to use objects, food items, body parts, or assigned textbook materials in learning and memory tasks.

Among the specific aids suggested for memorizing and problem solving were fingers, sticks, blocks, or plastic chips for counting, drawing circles or lines in multiplication, using pictures, place value charts, or number ladders. These aids were suggested 45 times in grades K through 5, most frequently in first grade (13 times). However, finger counting was also suppressed 10 times in grades 1 through 5, most frequently (5 times) in first grade.

10.) General Aids

In contrast to specific aids, teachers recommend the same general aid for a variety of different problems. These aids are designed and used to serve a general reference purpose. Children often have prior training in their use and -- once familiar with them -- are expected to utilize them without further explanation. Examples include the use of dictionaries or other reference works.

General aids suggested to students for problem solving were such reference works as dictionaries and glossaries, as well as general instructions to look in the library for more information on a certain topic, or to listen to people or watch T.V. to improve their vocabulary. This type of strategy was suggested 20 times by teachers from all grades except

kindergarten, most frequently in third and sixth grades (5 times each). One teacher in sixth grade suppressed the use of the dictionary for looking up the meaning of a word.

11.) Self-checking

Teachers instructing this strategy suggest to children to check their work for errors before turning it in. It includes procedures children can use on their own to make sure they are doing a task correctly. Teachers may also suggest that children test themselves or have someone else test them. Or, children might be encouraged to keep track of all steps involved in a task, so that they can later identify where they made a mistake. The instructions for this strategy are often not specific, but rather a general remark to "check the work."

Suggestions from this category usually included instructions to "make sure" that a task was done correctly, to reread and check answers before turning them in, to "check work" for errors, or to write down all steps involved in solving a problem so that errors could be traced later. This type of strategy was suggested by teachers of all observed grade levels a total of 24 times. It was most frequently suggested in third grade (8 times).

12.) Metamemory

Teachers instructing this strategy tell children that certain procedures will be more helpful for studying and remembering than others, and sometimes teachers may also explain why this is so. The strategy suggestion frequently includes hints about the limits of memory, asking children about the task factors that will influence ease of remembering, or helping them understand the reasons for their own performance. Teachers may ask children how they can focus memory efforts effectively, or what they can do to remember. Frequently, teachers also tell children that they can devise procedures that will aid their memory, and indicate the value of using a specific strategy.

Metamemory instructions typically included information on why a procedure would help, or asking children what they could do to remember. Some teachers told children that it was important to concentrate on the more difficult material when studying for a test. This type of strategy was suggested 17 times by teachers from grades 1 through 6, most frequently in second grade (6 times).

Analyses of Strategy Suggestions. The total number of strategies from each category that were suggested at each grade level are shown in Table 7 (frequencies combined across teachers). As indicated there, strategy suggestions are given

Table 7

Number of Instances in Which Each Strategy Suggestion Was Observed Among Teachers At Each Grade Level

	Grade Level			
	K-1	2-3	4-6	All Grades
n =	17	24	28	69
Category				
Rote	4	14	12	30
Elaboration	5	12	8	25
Attention	9	19	7	35
Attentional Aid	9	13	1	23
Transformation	3	10	7	20
Deduction	7	15	11	33
Exclusion	4	2	3	9
Imagery	2	9	0	11
Specific Aid	19	19	7	45
General Aid	2	7	11	20
Self-checking	3	11	10	24
Metamemory	1	9	7	17
Total Number of Strategies	68	140	84	292
Mean Number of Strategies	4.00	5.83	3.00	4.23

most often in the middle grades (2nd and 3rd). In order to compare the use of the various categories across grade levels, several analyses were performed. Teachers were grouped for these analyses by grade level and also by whether they made many or few strategy suggestions during observations. Teachers suggesting four or more strategies during observations were classed as high strategy teachers (7 teachers at grades K-1, 13 at grades 2-3, and 10 at grades 4-6) and teachers suggesting three or less strategies during observations were considered the low strategy group (10 teachers at grades K-1, 11 at grades 2-3, and 18 at grades 4-6). An initial analysis of variance was carried out on the total scores for all 12 categories, including grade level (3) and high-low strategy teacher as between-subjects variables and strategy (12) as a within-subjects variable. This analysis indicated that there were significant grade level differences in the tendency of teachers to suggest strategies, $F(2, 63) = 4.28$, $p = .018$. As indicated in Table 7, more strategy suggestions were given at grades 2-3 than at the lower or higher grade levels. A main effect of high-low strategy teacher, $F(1, 63) = 97.91$, $p = .000$, simply reflects the definition of this variable. Strategies differed in frequency of occurrence, $F(11, 693) = 3.26$, $p = .000$, as indicated in Table 7, where it can be seen that teachers most often suggested the use of specific aids, followed by suggestions for attention and deduction strategies. Strategy categories tended to vary in frequency as a function of grade level, $F(22, 693) = 1.48$, $p = .075$, and also varied as a function of whether the teacher is high or low in overall strategy suggestions, $F(11, 693) = 2.00$, $p = .026$.

In order to explicate the effects described above, analyses of variance were made of each of the strategy categories separately, using both grade level and high-low strategy teacher classification as variables. These analyses indicated that grade effects appeared only for the three categories involving the use of aids (attentional, specific, and general aids). Thus, an analysis of variance was carried out on just these three categories, involving grade level and high-low strategy teacher as between-subjects variables, and type of aid as a within-subjects variable. The analysis indicated a significant interaction of grade level by aid type, $F(4, 126) = 3.32$, $p = .013$, shown in Figure 2. As indicated there, suggestions for specific aids for problem-solving were made often at the lowest grade level and continue in frequent use at grades 2-3, but decline greatly at the highest grade level. Suggestions for the use of attentional aids, similarly, are common at the two lower grade levels and decline greatly in use at the highest grade level. Suggestions for general aids, on the other hand, show a fairly regular increase over grades, peaking at the highest grade level. Specific aids are suggested more often than other types of aid, $F(2, 126) = 5.40$, $p = .006$, and this is particularly true for high strategy teachers, $F(2, 126) = 3.66$, $p = .028$. Teachers who often suggest strategies mention

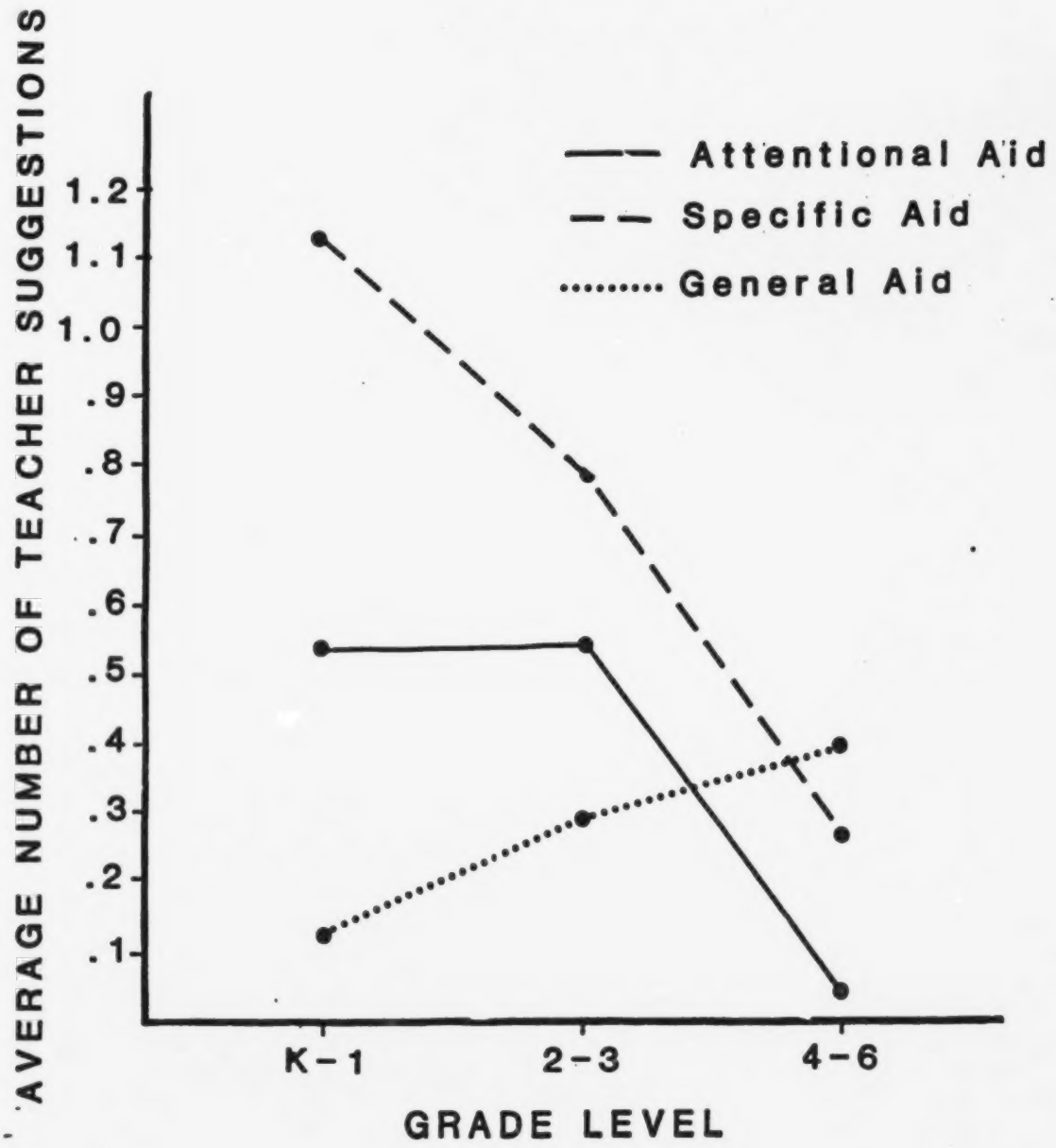


Figure 2. Teachers' Suggestions Concerning the Use of External Aids

category that were suppressed by teachers, no statistical analyses were performed on those data. Attempts to suppress strategies most often involved suggestions to stop or avoid the use of specific aids (in 10 of the 15 cases in which teachers attempted to suppress strategy use).

In summary, teachers used a variety of strategy suggestions, ranging from those concerned with fairly rote (nonmeaningful) procedures to several in which the aim was to increase appropriate understanding of the subject matter by use of both previous knowledge and information available in the materials constituting the lesson. Suggestions for the use of learning aids changed dramatically over grade level, from an emphasis on specific attentional and problem-solving aids among young children to an increasing use of suggestions for more general aids at grade 4 and beyond.

specific aids (M = 1.23) more often than attentional aids (M = .60) or general aids (M = .47). Low strategy teachers show less difference in the frequency with which they suggest the three aid types. Other significant effects that are qualified by the interactions above indicate a grade level difference and a difference between high and low strategy teachers.

A final set of analyses attempted to determine the effect upon category suggestions of the subject matter taught in the classroom during observations. It was demonstrated earlier that suggestions for cognitive processes were made more often in lessons that included mathematics than in those involving only language arts activities. Therefore, it is reasonable to presume that at least some types of strategy suggestion should vary in frequency with subject matter. In order to investigate this, data for each of the 12 strategy categories separately were subjected to an analysis of variance involving grade level, high-low strategy teacher, and subject matter as variables.

Subject matter had a significant effect on the use of several categories. The transformation strategy was used more in mixed subject matter (M = .48) than in language arts classes (M = .04), $F(1, 57) = 9.93$, $p = .003$. This difference was stronger among high strategy teachers than among low strategy teachers, $F(1, 57) = 6.61$, $p = .013$. Specific aids were also used more often in mixed subject matter classes (M = 1.03) than in language arts classes (M = .14), $F(1, 57)$ = 11.96, $p = .001$. Conversely, two other categories were used more often in language arts classes. Deduction was more common in language arts (M = .79) than in mixed subject matter observations (M = .25), $F(1, 57) = 19.77$, $p = .000$, especially among high strategy teachers, $F(1, 57) = 18.27$, $p = .000$. And, finally, exclusion was used more often in language arts (M = .21) than in mixed topic classrooms (M = .08), $F(1, 57)$ = 6.73, $p = .012$, with differences shown primarily by high strategy teachers, $F(1, 57) = 4.07$, $p = .048$. Thus, for four of the twelve strategy categories, subject matter differences influenced usage in ways that reflect the demands of the subject matter. Effective mathematics instruction involves helping the child access the meaning of concepts either by concrete representation through the use of specific aids or in the use of transformation strategies that show the relationship between the concept being learned and some simple, already mastered concepts the child possesses. Language arts instruction, on the other hand, often requires the child to use the materials given (letter, word, sentence or picture context) in order to deduce the meaning of a word or larger unit of text, when such meaning is not initially available to the child. Exclusion, a less frequent strategy suggestion, was sometimes mentioned as a technique for dealing with language arts workbook exercises or tests in which some variant of a multiple choice format was present.

Because of the small number of strategies from each

Teachers' Views of Children's Memory Skills: Questionnaire

In order to learn about how teachers view their children's memory and study strategy skills, we asked each teacher to complete a questionnaire developed on the basis of the memory development literature. The questionnaire asked teachers to report on their expectations for task performance by children of three achievement levels: high, average, and low achievers. They were also asked to tell us what they would expect of the "ideal" child of the grade level that they taught On some items, they also told us what they thought the "best" answer would be, in terms of successful memory performance. The tasks were constructed to tap different aspects of memory task performance, metamemory, and self-regulatory skills.

Method

Subjects. Analyses were carried out for questionnaires obtained from 59 teachers, including 16 teachers of children in grades K and 1, 19 teachers of grades 2 and 3, and 24 teachers of grades 4 through 6. These teachers had participated in the classroom observations and had also been interviewed prior to their being asked to complete the questionnaire. Three teachers did not complete the questionnaire parts of the study at all, one because she took a leave of absence from school. Data from seven additional teachers who had worked on parts of the questionnaire were eliminated from analysis because important questionnaire items were not answered. There were no consistent patterns of ommision of items by these teachers; rather, failures to complete parts of the questionnaire appeared to reflect hurried or careless responding.

Questionnaire. The questionnaire contained sections dealing with teachers' views of several aspects of memory development. The first section, entitled "How Children Carry Out Memory Tasks," (Table 8) was concerned with memory task performance. It describes three tasks often used in memory research, and asks teachers to indicate how they would expect the children in their classes to deal with each of these tasks. Teachers were asked to indicate how they would expect children in their high, average, and low achievement groups to perform, what they would expect of an ideal child of that grade level, and which answer would be the best in terms of successful completion of the task. The tasks tapped views concerning a relatively unsophistocated skill (rehearsal for serial recall), a more complex skill (organizing to-be-recalled items according to semantic relationships), and another more complex developmental acquisition, the ability to self-test in order to regulate strategy use during study for recall.

The second part of the questionnaire assessed the

Table 8

Items Assessing Teachers' Expectations for Children's Memory Strategy Use

How Children Carry Out Memory Tasks

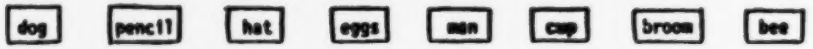
We have written descriptions below of some memory tasks that children might perform and ways that they could study in order to remember. Alternative ways of studying are given under "A", "B", "C", and "D".

Please answer the questions by circling the letter of the alternative that you think would be most characteristic of the group of children specified. Notice that we would like you to consider first the five children in your class who are the most outstanding achievers. Next, please answer for five children who are about average in achievement in your classroom. Then, consider the five children in your classroom who are lowest in achievement, and indicate how they might approach each memory activity.

Next, we would like you to think about what you would expect of an IDEAL child of the grade level you teach: That is, a child who is performing appropriately for his/her developmental level and whom you would enjoy having as a member of your class. Please answer the next question for this IDEAL child.

The last question asks you to evaluate the alternative study activities, in terms of which would be the best one to use in preparing for recall.

The child is shown a set of pictures of common objects, arranged in a row on cards like that shown below. The goal of the task is for the child to recite the list of pictures in order, from left to right, when the pictures are no longer in view. The child is given two minutes to study the pictures, and his or her study behavior is observed. Recall is checked at the end of the two-minute period.



A. The child looks at the pictures at the start of the study period but gets distracted by other things in the room for most of the last minute.

B. The child says the names of the pictures one at a time, repeating each label five times in a row. Rehearsal would sound like this: "Dog, dog, dog, dog, dog, pencil, pencil,..."

C. The child says the names of the pictures consecutively, from left to right, first while looking at the pictures and then with his eyes turned away. Rehearsal would sound like this: "Dog, pencil, hat, eggs, man, cup...."

D. The child looks carefully at each of the pictures and is not distracted from the task during the two-minute period.

Which of the study activities above would you expect the five children in your class who are <u>highest</u> in achievement to use? (Circle one) A B C D

Which of the study activities above would you expect five children in your class who are average in achievement to use? A B C D

Which of the study activities above would you expect the five children in your class who are <u>lowest</u> in achievement to use? A B C D

Which of the activities would you expect from the IDEAL child of the grade level you teach? A B C D

Which of the four activities would be the <u>most</u> useful in preparing for recall? A B C D

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teacher's views of children's metamemory abilities. An example of the items used here is shown in Table 9, entitled "What Children Know About Memory." The five items used were constructed to represent fairly simple acquisitions of metamemory knowledge that should already be present at the lower grade levels (savings in relearning, factors affecting loss of information from short term memory) and also more complex concepts that are typically acquired later in development (retroactive interference, gist versus verbatim recall, and primacy-recency effects). Items were taken from Kreutzer, et al. (1975) and from Moely, Leal, Taylor & Gaines (1981). Again, teachers were asked to read alternative answers for each item and to indicate what they would expect of the children in their classrooms. As before, separate evaluations were obtained for high, average, and low achievers, for the ideal student of the grade level, and for the "best" answer that a child could give.

The third part of the questionnaire, the Children's Memory Abilities Scale (CMAS) was concerned with several aspects of children's memory abilities. Items were developed on the basis of a review of the literature to tap various aspects of children's memory knowledge that were not assessed in the second section, above (knowledge about studying: that one should study in different ways for different kinds of test, that length of study is often correlated with amount learned, that it is easier to study in a quiet place than a noisy one; knowledge about materials to be learned: that amount of material to be learned is related to task difficulty, that familiarity of material affects ease of learning, and being able to distinguish easy from difficult items; and one item assessing knowledge about learners: that age of child is often related to learning ability). Next, memory strategy use was assessed by asking teachers to describe their children's use of a variety of strategies that ranged from fairly rote activities (say the names of items over and over, write items over and over) to strategies based on elaboration of the meanings of items to be learned (relate items by making up a sentence about them, group related items together, create visual images), to a higher order self-regulatory strategy (plan and organize work). Finally, memory monitoring, the ability of children to keep track of how their studying is proceeding and to understand the operations of their own ongoing memory processes as the basis for self-regulation, was assessed in several items that asked teachers to judge their students' abilities. Items asked if children could evaluate how well they knew something (can the child determine whether or not more study is needed, can the child judge whether a test answer is correct; can the child distinguish between things not known and things previously known but temporarily forgotten, can the child predict exam performance) and if they could make appropriate decisions about how to study effectively (can child apportion study time according to item difficulty, can child judge relative effectiveness of two ways of studying, will child study

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Table 9

Items Assessing Teachers' Expectations for Children's Memory Knowledge

What Children Know About Memory

Below we have written some descriptions of situations in which a child is asked about memory activities. Please read each description and then think about how you would expect the children in your classroom to answer the questions about each situation. We have provided four different answers that children might give for each item, labeled "A", "B", "C", and "D".

Please answer the questions by circling the answer that you would expect to hear from the groups of children indicated. Notice that we would like you to consider first the five children in your class who are the most outstanding achievers. Next, please answer for five children who are about average in achievement in your classroom. Then, consider the five children in your classroom who are lowest in achievement, and indicate how they might answer each question.

Next, we would like you to think about what you would expect of an IDEAL child of the grade level you teach: That is, a child who is performing appropriately for his/her developmental level and whom you would enjoy having as a member of your class. Please answer the next question for this IDEAL child.

The last question asks you to evaluate the alternative answers, in terms of which would be the best answer for a child to give.

"Jim and Bill are in school class. The teacher wanted them to learn the names of all the kinds of birds they might find in their city. Jim had learned them last year and then forgot them. Bill had never learned them before. Do you think one of these boys would find it easier to learn the names of all the birds? Which one? Why?"

A. "It would be easier for Jim, because he would remember about the birds from what he had learned before."

B. "It would be easier for Bill, because he wouldn't get the names confused with what he had learned before."

C. "It would be easier for Jim, but I don't know why."

D. "I don't know."

Which of the answers above would you expect from the five children in your class who are <u>highest</u> in achievement? (Circle one) A B C D

Which of the answers above would you expect from five children in your class who are <u>average</u> in achievement? A B C D

Which of the answers above would you expect from the five children in your class who are <u>lowest</u> in achievement? A B C D

Which of the answers would you expect from the IDEAL child of the grade level you teach? A B C D

Which of the four alternatives is the BEST answer a child could give? A B C D

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Table 8, continued

The child is shown a set of pictures of common objects, arranged on cards in a random display like that below. The child is told that he or she should learn the names of the cards, in order to repeat them from memory. The cards can be recalled in any order that the child wants to use. The child is given three minutes to study the pictures, and his or her study behavior is observed. Recall is obtained at the end of the three-minute study period.

A. The child looks at the pictures at the start of the study period but gets distracted by other things in the room for most of the last minute.

B. The child says the names of the pictures over and over to him/herself, while looking at each in turn.

C. The child moves some items to put them in pairs with others (grouping, for example, sock and foot, hand and hot dog) but leaves other pictures unsorted.

D. The child sorts the items into categories of related things (food, clothing, and body parts) and studies them in these sets.

E. The child looks at the pictures intently and is not distracted from the task during the two-minute period.

Which of the study activities above would you expect the five children in your class who are highest in achievement to use? (Circle one) A B C D E

Which of the study activities above would you expect five children in your class who are average in achievement to use? A B C D E

Which of the study activities above would you expect the five children in your class who are lowest in achievement to use? A B C D E

Which of the activities would you expect from the IDEAL child of the grade level you teach? A B C D E

Which of the five activities would be the most useful in preparing for recall? A B C D E

Suppose that the child received a task just like the last task described above, but with one change in the instructions. Now the child is asked to study the items as long as he or she wants to, and to indicate when he/she knows them by ringing a bell. When the bell is rung, the teacher will ask the child to recall the items seen.

A. After studying, the child gives him/herself a little "test" to see if he/she knows all of the items. When the child can say them correctly in practice, he/she will ring the bell.

B. The child will say each item to him/herself a fixed number of times (e.g., three times, five times) and then will ring the bell.

C. The child will look at some of the items, and then will ring the bell.

D. The child will look at and say each item just one time, and then will ring the bell and say the items as quickly as possible.

Which of the study activities above would you expect the five children in your class who are highest in achievement to use? (Circle one) A B C D

Which of the study activities above would you expect five children in your class who are average in achievement to use? A B C D

Which of the study activities above would you expect the five children in your class who are lowest in achievement to use? A B C D

Which of the activities would you expect from the IDEAL child of the grade level you teach? A B C D

Which of the four activities would be the most useful in preparing for recall? A B C D

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Table 9, continued

"If you wanted to phone your friend and someone told you the phone number, would it make any difference if you called right away after you heard the number or if you got a drink of water first? Why?"

A. "I don't know."

B. "It wouldn't make any difference whether you called right away or got a drink first."

C. "It would be better if you phoned first, but I don't know why."

D. You should phone first, because otherwise, you might forget the number while you went to get a drink."

Which of the answers above would you expect from the five children in your class who are highest in achievement? (Circle one) A B C D

Which of the answers above would you expect from five children in your class who are average in achievement? A B C D

Which of the answers above would you expect from the five children in your class who are lowest in achievement? A B C D

Which of the answers would you expect from the IDEAL child of the grade level you teach? A B C D

Which of the four alternatives is the BEST answer a child could give? A B C D

"One day two friends went to a birthday party and they met eight children that they didn't know before. I'll tell you the names of the children they met: Bill, Fred, Jane, Sally, Anthony, Jim, Lois, and Cindy. After the party one friend went home and the other went to practice a play that he was going to be in. At the play practice he met seven other children he didn't know before, and their names were Sally, Anita, David, Maria, Jim, Dan, and Fred. At dinner that night both children's parents asked them the names of the children they met at the birthday party that day. Which friend do you think remembered the most, the one who went home after the party, or the one who went to practice in the play where he met some more children? Why?"

A. "The one who went straight home would remember more, but I don't know why."

B. "The one who went to the play would remember more, because some of the children at the play had the same names as those at the party, so it would remind him."

C. "I don't know."

D. "The one who went straight home would remember more, because he wouldn't get mixed up by hearing all the other names of the children at the party."

Which of the answers above would you expect from the five children in your class who are highest in achievement? (Circle one) A B C D

Which of the answers above would you expect from five children in your class who are average in achievement? A B C D

Which of the answers above would you expect from the five children in your class who are lowest in achievement? A B C D

Which of the answers would you expect from the IDEAL child of the grade level you teach? A B C D

Which of the four alternatives is the BEST answer a child could give? A B C D

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Table 9, continued

"The other day I played a record for a girl. I asked her to listen carefully to the record as many times as she wanted so she could tell me the story later. Before she began to listen to the record, she asked me one question. 'Am I supposed to remember the story word for word, just like on the record, or can I tell you in my own words?' Which would be easier for her to do, to learn the story word for word, or in her own words? Why?"

A. "I don't know."

B. "It would be easier for her to learn to say it in her own words, because she could just explain the general idea. If she had to do it word for word, she might forget some of the words and that would ruin the whole story."

C. "It would be easier for her to learn to say it word for word, because she would listen to each of the words on the record very carefully."

D. "It would be easier for her to learn to say it in her own words, but I don't know why."

Which of the answers above would you expect from the five children in your class who are highest in achievement? (Circle one) A B C D

Which of the answers above would you expect from five children in your class who are average in achievement? A B C D

Which of the answers above would you expect from the five children in your class who are lowest in achievement? A B C D

Which of the answers would you expect from the IDEAL child of the grade level you teach? A B C D

Which of the four alternatives is the BEST answer a child could give? A B C D

A person asking questions shows the child cards that have pictures of common objects on them. "Now suppose I wanted you to remember these pictures, so that you could say them back to me in the same order that I use when I show them to you. Which ones do you think would be easiest to remember: the ones I show you first, the ones at the end of the set, or the ones in the middle? Why?"

A. "They would all be the same. It wouldn't make any difference if they came first or last or in the middle."

B. "The ones at the end would be easiest to remember, because you just finished seeing them and would still have them on your mind."

C. "The ones at the beginning would be easiest, because you saw them first."

D. "I don't know."

Which of the answers above would you expect from the five children in your class who are highest in achievement? (Circle one) A B C D

Which of the answers above would you expect from five children in your class who are average in achievement? A B C D

Which of the answers above would you expect from the five children in your class who are lowest in achievement? A B C D

Which of the answers would you expect from the IDEAL child of the grade level you teach? A B C D

Which of the four alternatives is the BEST answer a child could give? A B C D

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differently when recall is expected than when no such test is to be given).

The CMAS consisted of 21 items (7 tapping each of the domains described above), randomly arranged in two different orders for presentations. Teachers were asked to work through the items so as to describe children in their classrooms who were high achievers, average achievers, and low achievers, and also to describe the "ideal" child for the grade level taught. A response sheet is shown in Table 10.

Results

Analyses were made to examine teachers' expectations for children's memory skills and knowledge. The first question concerned teachers' views of memory strategy use by children. Responses made on questions concerning strategy use in serial recall, free recall, and recall readiness tasks were examined, as were items concerned with memory strategies taken from the CMAS. For both the free recall and recall readiness tasks, teachers' expectations for strategic behavior increased over grade level (Table 11). Major differences were also expected as a function of children's achievement level, with increasing use of appropriate strategies expected among students of higher achievement levels. For serial recall, viewed by teachers as the easiest of these three tasks, no grade differences were found. Teachers expected both high and average achievers to use appropriate strategies (rehearsal) in serial recall. In their evaluations of the seven strategies queried on the CMAS, teachers showed strong expectations for variation in performance as a function of the child's achievement level, as indicated in Table 12, and showed grade differences in expectations on several scales. For two relatively immature strategies (saying or writing items repeatedly), teachers' expectations varied as a function of both grade level and achievement criterion: Teachers at grades K-1 expected high use of these immature strategies by their high achievers, teachers at grades 2-3 expected highest use by average achievers, and teachers at grades 4-6 expected high use by low and average achievers. Self-testing as a way to evaluate learning was expected to increase with achievement level among teachers at grades K-1 and 4-6; for teachers of grades 2-3, average as well as high achievers were expected to show high use of self-testing. Other items concerning strategy use did not show grade level differences that might be expected on the basis of the memory development literature, although teachers were likely to describe achievement level differences within their classrooms.

Teachers' views of their children's memory knowledge was assessed with items concerning metamemory and seven items from the CMAS (Table 13). On all items, teachers expected major differences as a function of achievement level. An exception is an item on the CMAS concerned with age differences in memory ability, for which teachers expected low achievers to

Table 10.

The Children's Memory Abilities Scale

Children's Memory Abilities

In this section, we'd like to get an idea of what the children in your class know and can do about memory. We have written very brief descriptions of some kind of skill or understanding that a child might have. Please go through the set of descriptions and consider in turn each of the following groups:

First, think of the five children in your class who are the most outstanding achievers. Which of these skills or concepts would you expect these children to have? Please check in Column #1 all that you would expect your five top achievers to show.

Second, consider five children in your class who are about average in achievement. Which of these skills or concepts would you expect your five average achievers to show? Please check all skills that are characteristic of the "average achiever" in Column #2.

Third, consider the five children in your class who are the lowest achievers. Which of these skills or concepts would you expect your lowest achievers to show? Please check all of the skills they would show in Column #3, labeled "low achiever."

Finally, in Column #4, labeled "IDEAL," please check those skills and concepts that you would expect of an IDEAL child of the grade level you teach; that is, a child who is performing appropriately for his/her developmental level and whom you would enjoy having as a member of your class.

#1 Top achiever	#2 Average achiever	#3 Low achiever	#4 IDEAL	
____	____	____	____	Children are able to judge the relative effectiveness of two different ways of studying the same material.
____	____	____	____	Children are able to plan and organize their study activities without assistance.
____	____	____	____	Children engage in self-testing to see if they have learned something (e.g., giving themselves the test, practicing the steps involved to see if they can get them right, etc.).
____	____	____	____	Children know that they should study in different ways for different kinds of tests--distinguishing, for instance, between a multiple-choice and an essay test, or a true-false and a short answer test.
____	____	____	____	Children write items over and over as a way of remembering them.
____	____	____	____	Children can distinguish harder from easier study items.
____	____	____	____	Children are able to divide their study time so that difficult items are studied for a longer time than are easy items.

#1 Top achiever	#2 Average achiever	#3 Low achiever	#4 IDEAL	
____	____	____	____	Children are able to make up a sentence about two unrelated items as a way of remembering them together.
____	____	____	____	Children are able to judge correctly that they know something and don't need to study it further.
____	____	____	____	Children realize that a shorter list is easier to remember than a longer one.
____	____	____	____	Children are able to distinguish between things they don't know and things they have known in the past but can't think of at this moment.
____	____	____	____	Children are able to predict accurately how well they will do on exams at school.
____	____	____	____	Children realize that studying longer will lead to better learning than very brief study will.
____	____	____	____	Children are able to study items by saying the names of the items over and over to themselves.
____	____	____	____	Children know that grouping together related items can be helpful in trying to remember them.
____	____	____	____	Children realize that it is easier to study when one's surroundings are quiet than when a great deal of noise is going on.
____	____	____	____	Children know that familiar things will be easier to learn than are things entirely new to them.
____	____	____	____	Children are likely to use different kinds of study techniques when told to "remember" something than they will if told simply to look over the material.
____	____	____	____	Children believe that older children are better able to remember things than younger children are.
____	____	____	____	Children are able to judge whether an answer given on a test is correct or incorrect.
____	____	____	____	Children say that they can create visual images in order to help them remember.

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Table 11

Changes in Teacher Expectations for Recall Task Performance as a Function of Grade Level

	Grade Level			
	K-1 (n=16)	2-3 (n=19)	4-6 (n=24)	OVERALL (n=59)
Free recall	1.08	1.34	1.40	1.29
Recall readiness	1.33	1.58	1.79	1.60
Serial recall	1.67	1.68	1.78	1.72

Table 12

Mean Scores Assigned to High, Average, and Low Achievers by Teachers for Memory Strategy Items from the CMAS.

Memory Strategy Item	Achievement Level			
	High	Ave	Low	Overall
1) Children are able to study items by saying the names of the items over and over to themselves.	.61	.81	.59	.67
2) Children write items over and over as a way of remembering them.	.44	.63	.64	.57
3) Children say that they can create visual images in order to help them remember.	.69	.33	.07	.37
4) Children are able to make up a sentence about two unrelated items as a way of remembering them together.	.49	.17	.03	.23
5) Children engage in self-testing to see if they have learned something (e.g., giving themselves the test, practicing the steps involved to see if they can get them right, etc.).	.83	.47	.12	.47
6) Children know that grouping together related items can be helpful in trying to remember them.	.80	.42	.15	.46
7) Children are able to plan and organize their study activities without assistance.	.74	.25	.00	.33

Table 13

Mean Scores Assigned to High, Average, and Low Achievers by Teachers for Memory Knowledge Items from the CMAS.

Memory Knowledge Items	Achievement Level			
	High	Ave	Low	Overall
1) Children realize that a shorter list is easier to remember than a longer one.	.86	.85	.73	.81
2)Children know that familiar things will be easier to learn than are things entirely new to them.	.81	.76	.51	.69
3) Children can distinguish harder from easier study items.	.85	.71	.42	.66
4) Children realize that it is easier to study when one's surroundings are quiet than when a great deal of noise is going on.	.83	.69	.32	.62
5) Children realize that studying longer will lead to better learning than very brief study will.	.71	.51	.22	.48
6) Children know that they should study in different ways for different kinds of tests--distinguishing for instance, between a multiple choice and an essay test, or a true-false and a short answer test.	.54	.20	.03	.26
7) Children believe that older children are better able to remember things than younger children are.	.39	.49	.59	.49

show greater awareness than high achievers did. Although there was no grade difference on the metamemory items, responses varied with grade level for memory knowledge items on the CMAS. This effect reflected teachers' expectations for increasingly complex knowledge over grade. When individual items were examined, a statistically significant grade difference appeared only for an item concerned with children's awareness of the need to vary study depending upon the nature of the examination that would be used to assess knowledge. Teachers at the highest grade level expected children to show such understanding to a greater extent than teachers at the earlier grades did.

Teachers' views of their children's ability to monitor the state of their knowledge or to use appropriate control processes to regulate study were examined on several items from the CMAS (Table 14). On these items, again, teachers showed strongly different expectations as a function of the child's achievement level; however, there were no differences as a function of grade level. Overall, there was less difference between teachers of different grades in their expectations for metamemory and memory monitoring and control activities than might be expected on the basis of the research literature. Lack of change across grade appears to reflect the high expectations for children by teachers at the earlier grade levels.

Analyses of teachers' expectations of the ideal child of the grade level taught revealed no differences by grade, indicating that teachers had perhaps unrealistically high expectations at some age levels for the performances of their children. On the metamemory recall performance items, teachers were also asked to indicate the alternative that they considered the "best" response. Analyses indicated that teachers' "ideal child" was significantly lower (less mature, less accurate) on each measure than the teacher's view of the "best" response, but that this discrepancy did not vary across grade level. Teachers thus held idealized views of what their children should be able to do that did not differ across grade level, but that were less mature than their own ideal of excellent ("best") performance.

Discussion

This study attempted to find out what teachers do in the elementary school classroom to encourage study and memory strategy use and also, assessed their knowledge of children's developing memory and metacognitive skills. Little information on how memory activity is regulated or encouraged in the classroom has previously been available. Such information is important to our understanding of how memory processes, the capacity to generate effective strategies, and the understanding of components of memory develop in the young child. Similarly, little information has previously been

Table 14

Mean Scores Assigned to High, Average, and Low Achievers by Teachers for Memory Monitoring and Control Items from the CMAS

Memory Monitoring Item	Achievement Level			
	High	Ave	Low	Overall
1) Children are able to distinguish between things they don't know and things they have known in the past but can't think of at this moment.	.71	.54	.31	.52
2) Children are likely to use different kinds of study techniques when told to remember something than they will if told simply to look over the material.	.81	.47	.24	.51
3) Children are able to judge whether an answer given on a test is correct or incorrect.	.80	.46	.08	.45
4) Children are able to judge correctly that they know something and don't need to study it further.	.85	.44	.03	.44
5) Children are able to predict accurately how well they will do on exams in school.	.69	.32	.12	.38
6) Children are able to divide their study time so that difficult items are studied for a longer time than easy items.	.64	.36	.05	.35
7) Children are able to judge the relative effectiveness of two different ways of studying the same material.	.69	.17	.00	.29

available about how teachers conceptualize children's memory skill or knowledge. The several components of the present study attempted to gain information about how teachers teach memory, as well as how they conceptualize its development.

In the first part of the study, an observational scheme involving both time- and event-sampling components was developed, in order to learn about teacher encouragement of study and memory activity. The observational scheme was one that could be used reliably to observe teaching activity in classrooms of grades K through 6. Although some previously used observational schemes have been concerned with the teacher's influence on cognitive processes in children's learning (Dunkin & Biddle, 1974; Simon & Boyer, 1974), none has been concerned with describing teacher's strategy suggestions or teachers' efforts to suppress strategy use in children, or with the teacher's encouragement of metacognitive understanding in children.

The observational scheme yielded four factors that reflect the nature of activities observed in the classroom, including interactive teaching, responses to children's errors, the conveying of task-related information, and finally, the factor of greatest interest for the present study, one concerned with cognitive processes and strategy suggestions. Observational categories grouping together to constitute this factor were the teacher's suggestions about strategy use, feedback about the importance of employing the strategy (a behavior seen as encouraging metacognitive understanding in the child), information about appropriate cognitive processes to be used in dealing with a task, directives to stop using a strategy that the teacher wanted to suppress, and finally, an infrequently used category, in which the teacher asks the child to give feedback by asking questions concerning the lesson or assignment. Thus, the factor analysis suggests that the tendency of a teacher to focus on the manner in which children should process information involves several interrelated activities that are relatively independent of other activities carried out in the course of classroom teaching.

A teacher can be active in the classroom without necessarily being concerned with providing information about how to process information effectively. The tendency to make such suggestions is not simply a matter of being an "active," "involved," or "concerned" teacher. What variables influence the teacher's tendency to offer suggestions about cognitive processes and strategic ways of dealing with classroom tasks? The present study suggests several aspects of the classroom environment that influence a teacher: 1) the grade level of the class, which reflects the level of cognitive development of children, has an effect on the teacher's tendency to give strategy suggestions and tends also to affect his or her emphasis on cognitive processes in general; and 2) the subject matter of the classroom also has an impact on the teacher's

concern for cognitive processing activities. Each of these aspects is considered in detail below. There may also be personal or educational background correlates of the teacher's tendency to engage in these activities, although limited efforts to identify these in the present study were not informative.

Of major interest in this research was the question of differences among grade levels in the ways in which teachers encouraged cognitive activity by children. There is an extensive literature demonstrating differences in the ways that children approach memory tasks (Brown, et al., 1983; Flavell, 1970; Hagen & Stanovich, 1977; Lange, 1978; Moely, 1977) and differential effects of training procedures as a function of the child's developmental level (Moely, et al., 1982; Pressley, et al., 1982). It was reasonable to expect, then, that teachers would also vary according to the grade level of the children they teach in the kinds of activities they encourage in children. Probably the most notable findings are that teachers' use of suggestions regarding cognitive processes and strategies tended to peak at the second-third grade level, and similarly, that strategy suggestions were shown significantly more at this grade than at either lower or higher levels. This finding accords well with the research literature, in which children of these grade levels have been shown to be unlikely to generate effective strategies in all but very simple learning situations and also unsophisticated in views of their own memory processes, but to be very amenable to training in memory strategy use (Leal et al., in press; Moely et al., 1969; Naus, Ornstein, & Aivano, 1977); Ornstein, Naus, & Stone, 1977; Paris, et al. 1982; Ringel & Springer, 1980). It appears that teachers have some awareness of the potential for training with children of this developmental level. Such an awareness may result from the fact that teachers interact closely with students and can observe when children are responsive to strategy instruction. On the other hand, subject matter at these grade levels becomes increasingly demanding. In mathematics, multiplication and division are introduced, procedures which are usually difficult for children to grasp. The use of specific aids in the form of manipulatives, i.e. aids for multiplication and division, is high at these grade levels. In the language/arts area, the requirements for learning of vocabulary and spelling words increase in second and third grade, which may account for the large number of rote learning, elaboration and deduction strategies suggested by teachers. Thus, teachers seem to be sensitive to the potential for students at the intermediate grade levels to benefit from strategy training, and this sensitivity, combined with the increased demands of the subject matter at these grade levels for independent study and effective memory activities, may combine to produce a focus on effective study and memory strategy emphases in teaching.

Examination of the nature of teacher behaviors occurring

in conjunction with strategy suggestions revealed another change over grade level that accords well with the developmental literature. Teachers were increasingly likely over grade level to accompany a strategy suggestion with an explicitly stated rationale for its use. The teacher might indicate that the strategy would aid memory or that it might help the child deal more effectively with a difficult task. Research has shown that developmentally mature children are more aware than younger of their own memory processes (Kreutzer, et al., 1975) and also better able to benefit from training in general cognitive strategies (Brown, et al., 1979). Teachers seem to show an implicit awareness of these developmental changes in their suggestions to children.

Another difference across grade level indicates that teachers are aware that children may need qualitatively different aids in their learning as they get older. Instructions to utilize Specific Attentional Aids and Specific Aids for Problem Solving were given more often to children at the lower grade levels, who would be expected to have more problems maintaining attention to a task and following the teacher's instructions. Teachers also encourage younger children to rely on representations of math and science facts by means of concrete objects. However, in the upper grades, teacher's suggestions shift to the use of general aids. At this stage, children who have learned how to use such aids as dictionaries, glossaries, or the library, can do so with minimal instruction. Teachers seemed to recognize the need to make children less dependent on the instructor's help, and thus prepare them slowly for the tasks to be encountered in later grades. The shift in type of aid suggested across grade levels therefore supports the hypothesis that most elementary school teachers have some notion of developmental changes in children's cognitive abilities.

Teachers' expectations for their children's memory abilities also showed an awareness of developmental change, in several areas that have been identified through research as ones in which notable improvements are shown with age. Teachers expected greater use of relatively mature recall strategies of organization and self-testing among children at the higher grade levels, a view that is well-supported by research literature (Flavell, et al., 1970; Moely, 1977). Increasingly complex memory knowledge was expected over grade level, as well, and variations in the nature of strategies used in memory tasks were described as a function of both grade and achievement levels. Again, these expectations are well supported by research literature on metamemory (Flavell & Wellman, 1977; Kreutzer, et al., 1975) and on the development of strategies in memory (Flavell, 1970; Hagen, Jongeward, & Kail, 1975; Leal, et al., in press; Moely, et al., 1969). Another very strong indication that teachers are aware of developmental change is the pervasive and strong differentiation that teachers made between expectations for their high, average, and low achievers. If one views this

classification as reflecting different developmental levels within a classroom, it is clear that individual teachers are highly tuned to expect differences in all kinds of memory abilities as a function of the relative maturity of the child. At the same time, however, there were a number of areas in which research has described notable developmental change during the elementary school years but in which teachers did not show differences in their grade-related expectations. In relationship to developmental changes in memory knowledge and monitoring and control processes described in the literature, it appears that teachers at the earlier grades (especially kindergarten and first grade) expected more mature and sophisticated memory skills than their children would be likely to demonstrate. Further, the lack of grade level differences in expectations for the "ideal" child of that grade also indicates overly optimistic views by teachers of young children of their children's cognitive and memory abilities.

A second variable affecting teachers' suggestions for study was the subject matter of the lesson on which the teacher and child were working. While interactive teaching, responses to error, and communication of task-related information factors were all relatively stable across different classroom lessons, the observational categories involved in Factor 2 were affected by the nature of the subject matter. More suggestions for how to deal cognitively with a lesson were made by teachers observed in lessons that involved mathematics activity than for those concerned only with language arts lessons. It seems reasonable that in teaching mathematics teachers would spend time helping children think through the processes involved in conceptualizing and carrying out the step-by-step procedures involved in mathematical performance. Subject matter differences were also shown for the use of several of the categories derived from analyses of the strategy suggestions made by teachers. Here, instruction that included mathematics more often involved the use of transformations and specific aid strategies, which are both useful techniques to help the child understand a mathematical procedure by assimilating it to something already known or representing it in a relatively concrete fashion. Language arts activities often involved deduction as a means of deriving meaning from text by using cues from the material (either from illustrations, content of the text, or from the word or grapheme environment in which the unknown unit was embedded) to make sense of the material being read. Similar strategies for reading comprehension have been described by Cunningham, Moore, Cunningham & Moore (1983), who discuss the importance in reading of attending to important information and using the content to infer information that is necessary for understanding.

In the analyses of the event descriptions made of teacher's suggestions about strategy use or suppression, it was found that several types of strategies were more often

instructed by teachers than others. Teachers often told children to use specific aids, rote learning procedures, strategies to direct and maintain attention, and deduction, while they seldom asked children to form an image of to-be-learned materials or to systematically exclude wrong choices to find the correct answer to a problem. Such findings can be explained on the basis of the special needs of elementary school teachers: Children need to be attentive in order to learn, and teachers therefore need to maintain their attention to the task through verbal task-specific prompts; children have to memorize many spelling and math facts that have low intrinsic meaning, a need which teachers seem to interpret as need for rote learning techniques; children also depend increasingly on applying knowledge learned in one task to other tasks, and may thus be required to "deduce" correct answers to problems on the basis of information they already possess in addition to using aspects of the new material; and finally, the use of specific aids, especially in the earlier grades, enables teachers to maintain the child's attention to the task or to demonstrate abstract principles in a concrete way.

The finding that specific aids constituted most of the "strategy suppressed" observations reflects the disagreement among elementary school teachers about whether or not to allow children to use their fingers as computational aids. Teachers who suppressed the use of fingers sometimes justified this by explaining to children that they would not be able to use their fingers when they began to work on problems that involved large numbers. As indicated by the analysis of teacher behaviors accompaying strategy suggestions, teachers often suggested another strategy at the same time that a spontaneous strategy such as finger use was suppressed. Thus, teachers who suppressed a strategy usually did so because they wanted children to use other strategies. An argument can be made that this is a developmentally appropriate decision on the part of the teacher, since as children move from very simple calculations, finger counting may become less efficient than other representional aids such as number lines or drawings made on paper of sets of items. Less in accord with such a developmental orientation, however, was the behavior of some first-grade teachers who seemed to suppress the use of fingers as computational aids from very early in math instruction. Siegler and his colleagues (Siegler, 1982, 1984; Siegler & Robinson, 1982: Siegler & Shrager, 1984) have suggested that finger counting is a useful procedure by which young children can form representations of mathematical concepts. Teachers who suppressed finger counting in young children sometimes told us that this was done in response to a school system policy against the use of fingers as computational aids. The same teachers sometimes encouraged children to use other aids such as blocks or number ladders to achieve the representation of number problems, a representation that may be particularly important in the early stages of mathematical concept acquisition.

An important cluster of strategies that teachers suggested, i.e. self-checking and metamemory instructions, have their basis in activities researched by several investigators (Brown, et al., 1979; Flavell, et al., 1970; Leal, et al., in press). Although suggestions made by teachers in the present study somewhat resembled those described in the literature, important differences are evident. For instance, when suggesting activities categorized as "self-checking" instructions, teachers usually gave only vague instructions for children to check their work before turning it in, or to keep track of steps involved in problem-solving so that they could go back later and find where they had made an error. Results from training studies (e.g., Leal, et al., in press) indicate that children need explicit instructions and feedback before they will benefit from strategy training. These were rarely provided by teachers observed in the present study. Instances in which teachers modelled self-checking procedures were not observed, although this might have substantially increased children's understanding of what self-testing means. In Chapter 3, below, evidence is presented to indicate that children of grades 1-3 rarely carry out effective self-checking activity in an arithmetic task similar to tasks given in school. At least at these early grades, children need instruction, demonstrations, feedback about performance, and other kinds of assistance to carry out effective self-checking.

Metamemory instructions made by teachers in the present study were usually limited to instructions that emphasized how certain materials would help children in learning. Other instructions gave information about why certain materials are more difficult than others and how they can be remembered. While these observations indicate that some teachers recognized that children learn more effectively if they are aware of their own memory processes, metamemory instruction was not extensive. Since results from training studies have indicated that feedback concerning strategy effectiveness may be an important part of strategy training (Black & Rollins, 1982; Kennedy & Miller, 1976; Pressley, et al., 1984; Ringel & Springer, 1980), children can only benefit from instructions to think about their cognitive capacity. If children are made aware of the limits of their memory, or made aware of the fact that some procedures are more advantageous than others, they are better able to monitor their progress toward mastery in a given task. Although metamemory suggestions showed a developmental increase, they never appeared with very high frequency in teachers' suggestions. One implication of this finding is that teachers should be helped to instruct metacognitive concepts in the context of classroom learning situations.

In conclusion, teachers were observed to employ a range of suggestions for cognitive processes and strategy use or suppression in their work in elementary school classrooms,

especially at the intermediate grade levels. Many of their suggestions appeared to be appropriate and potentially helpful aids to children's learning. Their expectations for children's performance reflected some awareness of developmental changes, but also showed a tendency to overestimate children's skills, especially at the early grades. The relatively brief, nonspecific kinds of suggestions teachers often made about how their children should use strategies may reflect their overestimates of children's abilities to carry out memory activities and to conceptualize memory phenomena. Teachers might have an even greater influence on children's learning if their strategy suggestions were more elaborated, more often included demonstrations, and especially at the intermediate and higher grades, included instruction in metamemory, focusing on the benefits to the child of using the strategy suggested. It appears that teachers could benefit by instruction designed to produce an increased awareness of developmental changes in memory and metamemory phenomena, a clearer view of what skills can be expected in a child of the grade levels they teach, and knowledge of the factors involved in effective training procedures to modify children's typical approaches to various learning tasks.

Chapter 3. Study Strategies, Metacognitive Skills, and Responses to Memory Strategy Training by Children Whose Teachers Differ in Use of Cognitive Strategy Suggestions

It was demonstrated in the first study that teachers vary considerably in the extent to which they suggest memory strategies, give rationales for these strategies, and describe cognitive processes useful in dealing with classroom tasks. The present study was an exploratory effort to determine how children are affected in their learning styles by exposure to teachers holding differing orientations toward cognitive instruction. Since more frequent use of strategy suggestions was found at the lower elementary grades, children of grades 1 through 3 were selected for participation in this research. On the basis of the observations made in the first study, it was possible to identify a number of competent and interested teachers who were similar on many of the measures obtained in the first study, but who varied in our observational data on the categories involved in Factor 2, Cognitive Processes and Strategies. Children of high, moderate, and low achievement levels from the classrooms of these teachers were seen in individual sessions, in which they were exposed to several tasks assessing memory strategy use, metacognitive knowledge about memory and study activities, and the capacity to profit by a simple training procedure designed to teach a memory strategy. The observations were carried out in the last month of the school year, when children had experienced approximately eight months with a teacher who either gave memory strategy suggestions frequently or rarely made such suggestions. After such extensive exposure to a particular teaching style, we felt that children might reflect their teacher's approach to memory tasks.

The tasks selected varied on their similarity to tasks the child might encounter in school. A free recall task, in which children could remember items effectively by employing a category grouping strategy, was used to assess initial strategy use and also, to evaluate the effects of a simple training procedure on performance immediately following training and also at a later point in the individual session. This task was probably quite novel for the children, different from the kinds of tasks typically found in the school setting. Two other tasks, more similar to school activities, were also used. One of these was a spelling task employing artificial words, a task developed for use in previous research on children's memory skills (Leal, et al., in press). The other task assessed strategy use and understanding in mathematics, an area in which we often saw teachers making suggestions about cognitive processes and strategies for understanding and retaining information.

The aims of the present study, then, were 1) to compare the performance of children varying in grade level,

achievement, and teacher's teaching style on several tasks measuring memory ability and strategy use, and 2) to evaluate the effects of a brief training procedure on subsequent recall task performance by children from these several groups.

Method

Subjects

A total of 64 children of high, moderate, and low achievement levels were selected from 13 classrooms. At the first grade level, 11 children (5 boys and 6 girls) were chosen from the classrooms of three teachers high in strategy use and suggestions about cognitive processes, while 12 children (7 boys and 5 girls) were from classrooms of two teachers low in such suggestions. Second graders were 15 children (8 boys and 7 girls) from three classrooms of high strategy teachers and 8 children (4 boys and 4 girls) from two classrooms in which teachers infrequently suggested strategy use or cognitive processing techniques. At the third grade level, there were 12 children (6 boys and 6 girls) from two classrooms in which teachers were high in strategy and cognitive suggestions, and 6 children (3 boys and 3 girls) from a classroom in which the teacher seldom made such suggestions. Within each classroom, the sample was stratified by sex and achievement level, for a total of 33 boys and 31 girls, including 24 high achievers, 21 moderate achievers, and 19 low achievers.

Achievement level was determined initially by the classroom teacher's recommendation, which was checked by obtaining the children's most recent scores on a standardized achievement test, the Comprehensive Test of Basic Skills (1975). Scores were percentiles based on national norms for this test. Children categorized as relatively low achievers averaged 47.6 (SD = 27.6) in reading achievement and 55.1 (SD = 26.1) in mathematics achievement. Moderate achievers averaged 65.4 (SD = 21.3) in reading and 75.9 (SD = 20.0) in math, and children classified as relatively high in achievement averaged 84.3 (SD = 14.0) in reading and 88.3 (SD = 16.4) in math achievement.

Children's ethnic background was varied, with 24 white, 32 black, and 7 Oriental children, as well as one child from a Spanish language backgroup in the sample. The mean chronological age of the first graders was 82.3 months (SD = 3.3). For second graders, mean age was 96.1 months (SD = 4.8), and among third graders, children averaged 107.8 months (SD = 5.9).

The thirteen teachers from seven schools whose classrooms were selected for the present study were identified on the basis of observations carried out in Study 1. Eight teachers were selected because they were observed to make frequent use of suggestions regarding cognitive processes and strategies,

while five other teachers were selected who appeared to be equally positive, enthusiastic, and interested teachers who rarely made suggestions about cognitive processes or strategies. In order to check the appropriateness of our choices, the eight high strategy teachers were compared with the five low strategy teachers on measures derived from the classroom observations. As expected, high strategy teachers suggested a greater total number of strategies during observations (M = 10.6) than did low strategy teachers (M = 3.0), $F(1,7) = 13.48$, $p = .008$. Also, high strategy teachers suggested strategies from a larger number of different categories (among the 12 categories described in Chapter 2) (M = 5.75) than did low strategy teachers (M = 2.6), $F(1,7) = 45.3$, $p = .000$. The two groups also differed on three variables included in Factor 2 (Cognitive Processes and Strategies), with teachers identified as high in strategy suggestions showing significantly more descriptions of cognitive processes, $F(1,7) = 27.9$, $p = .001$, more strategy suggestions, $F(1,7) = 9.64$, $p = .017$, and more rationales for strategy use, $F(1,7) = 5.57$, $p = .050$. Thus, for various measures indicative of suggestions about cognitive activities and processes to use in classroom work, the teachers selected as high were in fact appropriately different from those selected as low. It was our intention to identify groups of teachers who were different in this aspect of teaching style, but who did not differ in other ways. Data from the observations suggests that this was in fact the case. Teachers in the two groups did not differ on any of the variables included in Factor 1 (Interactive Teaching), Factor 3 (Teacher Responds to Errors), or Factor 4 (Communicating Task-Related Information). The groups also did not differ in the frequency with which procedural information was given, how often children's inquiries about lessons were requested, how often children were criticized, or how often attempts were made to suppress children's strategy use. Comparisons of high and low strategy teachers showed no differences between the groups in age, years since receiving Bachelor's degree, years spent in teaching, years of teaching the grade presently taught, and number of children in the classrooms at the time the present study was done.

Materials

For the free recall task, 40 line drawings measuring 6.3 x 6.3 cm (2.5 x 2.5 in) were prepared, depicting easy-to-label items from eight conceptual categories. The categories represented were animals, body parts, clothes, foods, fruits, furniture, people, and vehicles. Similar items have been employed in a number of studies investigating recall in elementary school age children (Black & Rollins, 1982; Moely & Jeffrey, 1974; Moely, et al., 1969).

The spelling task, adapted from Leal, et al. (in press), employed two-syllable, six-consonant nonsense words. These were formed from Witmer's association values of three-place

consonant syllables (Underwood & Shulz, 1960) by combining two syllables of 75% meaningfulness value (e.g., "grmlht," and "hsbmdg"). Each word was printed in lowercase letters on a 12.8 x 7.7 cm index card (3 x 5 in). Paper and pencils were made available to the child during study.

For the arithmetic task, materials included a booklet containing 12 arithmetic problems taken from the Stanford Diagnostic Mathematics Test (Beatty, Madden, Gardner, & Karlsen, 1976). Items were selected from several forms of the test to constitute increasingly difficult problems involving addition (5 problems), subtraction (3 problems), and multiplication and division (4 problems). Various objects were made available to children to use as counters, including blocks, sticks, and beads. Cuisenaire rods, a number line, and paper and pencils, any of which could be used by children to represent the arithmetic items, were also available. Two 15.2 x 10.2 cm cards (4 x 6 in) were used to present simple arithmetic problems during the interview section of the arithmetic task.

Procedure

Children were seen in individual sessions that lasted approximately 30 minutes. All children first received two trials on a free recall task. The initial trial (pretest) assessed their spontaneous use of organization and other study strategies, while the second (training) trial was used to provide simple instruction in the use of category organization during study and recall. Next, children received either the spelling or the arithmetic task, with the order of presentation randomly varied from child to child. The final task was always a third trial (posttest) on free recall, involving new items from different conceptual categories. This trial was used to assess the extent to which children would continue to use the category grouping strategy they had been taught. Experimenters were two females, who worked together initially with pilot subjects as well as with some of the research participants to establish comparability of procedures and to determine reliability of measurement. Subsequently, each tested children in individual sessions carried out in quiet rooms at the schools.

Free Recall Task. For the pretest on the free recall task, the experimenter randomly selected four categories of items, using five items per category with third graders, a randomly chosen 4 items per category for second graders, and a randomly chosen 3 items per category for first graders. For each free recall trial, then, first grade children received a 12-item list, second graders a 16-item list, and third graders, a 20-item list. This was done in an effort to equate task difficulty among the age groups, an effort that was not entirely successful (see Results, below), in that the recall was somewhat better for first graders than for the two older groups. The experimenter indicated that she was going to show

the child some pictures, and asked the child to label each item as it was presented. In the rare event that the child was unable to identify a picture, the experimenter would provide the appropriate label. When all items were exposed on the table, the experimenter told the child that he or she should study the pictures so that later on, when the pictures were concealed from view, the child would be able to recall all of them. Children were informed that they could recall the pictures in any order they wanted to use, that they could study in any way they chose, that they could move the pictures around during study, and that they should study until they knew all the pictures. After answering any questions the child might raise, the experimenter told the child to begin study. During study, the experimenter kept track of observed study activities. When the child indicated that he or she was finished, the experimenter covered the pictures, and requested and recorded the child's recall. The experimenter also recorded the time used for study and indicated whether the child had sorted the pictures during study into a complete category set, a partially categorized set, or had completed study with pictures in some non-category arrangement. When the child had completed recall, the experimenter showed the child the pictures again, still arranged as the child had placed them during study, and asked the child to describe 1) what he or she had done to learn the pictures; 2) how he or she had decided to stop studying; and 3) what he or she had been doing in attempting to remember the pictures (after they had been covered by the experimenter). Responses to these questions were coded for awareness by the child of categorizing, self-testing, or other strategies that could have been used during study or recall, in ways indicated below.

The next free recall trial involved a simple training procedure, in which the child was shown a category grouping strategy on the same items that had been used in the pretest. In the event that the child had grouped items on the pretest, the training was given, but amended to acknowledge that the child had indeed used this appropriate procedure in his/her own effort. (Only four children showed perfect category grouping on the pretest trial.) In training, the experimenter indicated first, that she would show the child a way to study that would help the child recall more items. Then, the experimenter began sorting pictures from one category, labeling the category as she did so, and encouraging the child to assist her in completing the sort. She proceeded in the same way through each of the four categories, eliciting the child's involvement in sorting as much as possible. The experimenter then explained that grouping the cards would make it easier to remember them, because the child could then recall by remembering that there were items from Category 1 and recalling those items, then remembering that there were items from Category 2 and recalling those items, and so on. Then the experimenter told the child to study the pretest pictures again, and to use the procedure that she had just

demonstrated to study and recall them. She reminded the child that this procedure would help the child remember more of the pictures, and also reminded the child that he or she was to indicate when study was complete. The child was then given a second study-recall trial. If the child failed to begin moving the pictures into groups durng the first 10-s study interval, the experimenter prompted the child to do so by explicitly instructing the child to put the items into groups. A prompt was given to 26 of the 64 children, who were divided quite equally among the grade, achievement, and teacher groups. An analysis of variance of scores for whether or not prompts were given showed no differences among groups and no interactions that would suggest a greater need for prompting by any subgroup in the sample. When the child indicated the completion of study, recall was again obtained, and the experimenter recorded time of study and the extent to which the items had been sorted by category during study. After recall, the experimenter again asked the child what he or she had done to learn the pictures, and pointed out to the child that recall had been improved by use of the grouping strategy. (This statement was true in all but eight cases, and in those cases, the experimenter modified the statement to indicate that recall is usually better when items are arranged into category groups, without emphasizing the difference between the child's own two trials.)

Following the spelling and arithmetic tasks (described below), the experimenter presented another free recall task, the posttest. The task was introduced in the same manner as the pretest, with the child labeling items as presented, and the experimenter indicating that the child should study in any way he or she pleased until ready to recall. Items used for the posttest trial were from four new categories, not used on previous trials. Again, first graders received a 12-item list, second graders received a 16-item list, and third graders received a 20-item list. Subsequent to recall, the experimenter asked the child the same three questions as were asked at the pretest, concerning study, the termination of study, and recall. A final question asked for the child's recollection of the procedures described in training, in order to determine the extent to which the child had retained the essential features of the instruction.

Spelling Task. First graders received two words to study in the spelling task, randomly chosen from a set of six available items, while both second and third graders received three randomly selected words. The experimenter introduced the task by showing the child the words and asking the child to spell each one aloud. Then, the experimenter told the child to study the words until he or she would be able to spell them aloud without looking at them. The child was shown paper and pencil and told that they could be used in study, that the child could study in any way he or she wanted, and that the child should indicate when study was completed. During the study period, the experimenter recorded the child's

study activities. When the child indicated completion of study, the experimenter covered the words and asked the child to spell each one aloud. The experimenter also recorded the time spent in study. After spelling was completed, the experimenter asked the child several questions, concerned with 1) what the child had done to learn to spell the words, 2) how the child decided when to stop studying, and 3) several questions concerned generally with how the child approached spelling tasks in the classroom. These questions were as follows: "If a kindergarten child asked you how s/he should study for his/her spelling tests next year, what would you tell him/her to do? How do you study for your spelling tests? What kinds of things do you do? What does your teacher tell you to do to learn your spelling words? What else?"

Arithmetic Task. The child was given a booklet containing the arithmetic problems, and asked by the experimenter to complete as many problems as he or she could. The experimenter indicated the counters, rods, number line, and pencil and paper that were available, and told the child that he or she could use any of them as needed in order to find the answers to the problems. The child was also told to take as much time as necessary to complete the task. As the child worked, the experimenter recorded use of materials, counting on fingers, lip movements in counting, tapping with a pencil or fingers, or other strategies. The experimenter stopped the child after four consecutive failures or at the end of the task, and asked the child to go back and "check" his or her work. Any problems corrected during this checking process were noted, and the child was asked to explain what he or she had done to check the work.

Subsequent questions in the arithmetic task were designed to give an impression of the child's metacognition concerning arithmetic concepts. Three topics were queried: First, the child was shown the most difficult addition problem that he or she had completed successfully. The experimenter told the child: "Look at this problem again. You did well, you got this one correct. Now suppose another child looked over your work and said that you DIDN'T have the right answer here. What could you do to prove to him/her that it really is the right answer?" The same question was asked for the most difficult subtraction problem that the child had answered correctly. Next, the child was shown two simple arithmetic problems (2 + 1 = 3 and 3 + 2 = 5) printed on cards. The experimenter asked the child to imagine that a little child in kindergarten, who doesn't know much about arithmetic, is asked to learn these two problems. "How could s/he learn them? What would you tell him/her to do to learn them?" Followup questions asked the child to find a way to explain to the child what it means to "add" numbers, and prompted the child with increasingly direct comments to use blocks or other counters to represent the problem. Finally, the child was asked two questions about how he or she learned number problems: "What helps you most when you're trying to learn

about numbers? Like, if you're trying to do hard number problems? What does your teacher tell you to do to find the answers to hard number problems? What else?"

Measures Obtained

Free Recall. On each of the three free recall trials, measures were obtained for recall performance, represented as the proportion of items presented that were correctly recalled. Formation of category groupings during study was coded by the experimenter, who rated the final sorting of items according to whether it showed complete category organization (2 points), partial grouping (1 point) or no organization by category (0 points). Clustering of items during recall was scored by means of the Ratio of Repetition (RR) Index (Frender & Doubilet, 1974). Study behaviors observed were coded by checking each activity that occurred during consecutive 10-s intervals. Activities recorded were looking at stimulus items, naming items while looking at them, moving pictures during study, and self-testing by attempting to say the names of items while looking away from them. (See Moely, et al. (1969) or Moely and Jeffrey (1974) for a more complete definition of each of these categories.) The amount of time spent studying (in seconds) was also recorded.

Responses given to interview questions concerning study activities were coded in the following manner: 1) Children's answers to questions concerning study were coded for mention of categorization of items as a way of studying (1 point) vs. no such mention (0 points). Coders showed 100% agreement in coding pretest responses, 98% agreement for the training trial, and 92% for the posttest trial in scoring the presence or absence of category mention by all 64 children. 2) Children's answers to questions about study were also coded according to whether the child mentioned the use of self-testing as a way to decide when to stop studying (2 points), whether the child mentioned some other systematic way of studying (1 point), or whether the child failed to describe any rationale for terminating study (0 points). Coders agreed 83% of the time for the pretest and 89% of the time for posttest protocals. On the pretest and posttest trials, children were asked to describe activities used during recall in order to remember the items. Responses to these questions were coded for mention of category organization (2 points), mention of some other organized patterning of recall (1 point), or no evidence of organization (0 points). Agreement in coding these responses was 91% on the pretest and 86% on the posttest trial. Finally, on the posttest trial, children were asked their recollection of the training instruction. Responses to this question were coded according to whether the child mentioned categorization as a study or recall technique, and coders agreed 97% of the time in classifying these responses.

Spelling Task. Performance in the spelling task was assessed by examining two accuracy scores: the proportion of words presented that were recalled correctly and the proportion of letters recalled that were recalled in the correct position in each word, measures previously used by Leal, et al. (in press). These two measures are not highly correlated (r = .28, p = .030), possibly because the word measure shows little variability. Time spent studying the spelling words was recorded, as were the several study activities that children might show during study, looking at items, naming the letters in the words, writing the words, and self-testing, by spelling the words while looking away from them. (See Leal, et al.,in press, for additional information about these activities.)

Interview questions given upon completion of the spelling task were evaluated independently by two coders, in the following ways: 1) Responses to questions about how the child had studied were coded according to whether the child mentioned self-testing as a way to determine the end of study (2 points), mentioned some other systematic way of studying (1 point), or failed to describe any organized way of studying (0 points). Coders agreed 81% of the time in their evaluations of these responses. For questions about studying spelling words in school, children's responses were coded for mention of several strategies, as follows: Self-testing was coded as a 2-point response when the child explicitly mentioned the value of self-testing as a way of providing feedback about how well items had been learned. Mention of self-testing without such a rationale was credited with 1 point, and no mention of self-testing received 0 points. Coders agreed 83% in scoring these responses. Use of rote methods was scored if the child mentioned use of simple strategies such as looking at, reading, saying, or writing the words repeatedly. Coders agreed 95% of the time in classifying these responses. Use of rules for spelling based on phoneme-grapheme correspondence or patterns of occurrence of letters in written English were coded with 91% agreement. Use of semantic elaboration or efforts to make meaningful connections between words or letters within words by reference to previous learning were coded with 92% agreement by raters.

Study Behaviors in Recall and Spelling. During the study periods in both the recall and spelling tasks, the experimenters recorded activities in which children engaged as they attempted to prepare for recall. Observers showed high agreement in the scoring of categories, which is expressed here in terms of agreements over the total of agreements plus disagreements, for trials on both recall and spelling tasks. For both Looking and Naming, agreement was .83. For Self-testing, agreement was 1.00. For Moving Pictures (recall task only), agreement was .95, and for Writing (spelling task only), agreement was .82.

Arithmetic Task. Each problem attempted on the arithmetic task was scored as either correct (1 point) or incorrect (0 points). Inspection of problems answered incorrectly was made independently by two coders to determine whether errors made were due to incorrect mathematical procedures or operations or incorrect mathematical facts. Coders agreed 90% of the time on errors classified as procedural and 81% of the time on errors classified as factual. Number of errors detected and corrected during the self-checking process was also recorded. The nature of each child's self-checking process was rated according to whether he or she reworked a problem or problems completely (2 points), systematically looked at problems completed without redoing them (1 point), or did nothing systematic during self-checking (0 points). Reliability for these ratings was 84% agreement.

Whether or not children used each of five different solution strategies (adapted from Siegler & Shrager, 1983) while working each arithmetic problem was recorded by using both the experimenter's records of strategies children showed while working the problems and actual markings in children's test booklets. These five solution strategies included no visible strategy use or retrieval, the use of the manipulatives available or one's fingers, to represent the problem, counting aloud or silently, using traditional arithmetic operations, and the use of symbolic processes to break the problem down into easier steps for solution. Coders showed 84% agreement in coding retrieval strategies, 93% agreement for manipulatives, 85% agreement for counting, 79% agreement for arithmetic oeprations, and 74% agreement for symbolic processes. Additionally, the proportion of each strategy's use on problems answered correctly was recorded, as well as proportion of each strategy's use on problems answered incorectly.

Responses to the three metacognitive interview topics were also evaluated independently by two coders. First, responses to the question concerning how to prove to another that an answer is correct were coded as to whether child mentioned using manipulatives, fingers, or mathematical operations (e.g., addition to prove subtraction) (2 points), mentioned less certain means of proof such as doing the problem again or asking teacher for correct answer (1 point), or made irrelevant comments (0 points). Percent agreement for scoring these responses was 97%. For the second topic, concerned with explaining the logic of an addition operation to a hypothetical younger child, responses received the maximum score (3 points) if child indicated that he or she would show child logic of addition by using fingers or manipulatives. If child indicated this response only after additional questioning, this response received 2 points. If additional prompts were necessary (e.g., child asked to use manipulatives in response), 1 point was scored. Reliability for coding these responses was 78% agreement. Finally,

responses to questions about how one can handle difficult problems were scored according to whether or not the child mentioned any of the following: using arithmetic operations (e.g., breaking problem down into an easier problem); using manipulatives, external aids, or fingers; using external aids for memory purposes (e.g. flashcards); engaging in rote memory exercises to learn math; getting help from another person; self-checking work completed; and practiced math problems. Reliability for these reponses ranged from 78% agreement (use of arithmetic operations) to 100% agreement (rote memory exercises to learn math), with a median agreement value of 92%.

Results

Findings for three aspects of this study are presented below. The free recall task was used to examine grade, teacher, and achievement level differences in children's use of a strategy before, immediately following, and subsequent to instruction in the use of that strategy, as well as their use of other non-instructed strategies. The child's ability to describe strategy use during study and recall and to recollect verbally the essential features of training was also examined. The second aspect of the study concerns children's performance on the spelling task, a task similar to those encountered regularly in school. Finally, the arithmetic task was used to assess strategies and metacognitive understanding of mathematical concepts and processes.

Free Recall Task

As indicated above, children received three trials in free recall: a pretest was given at the beginning of the session to assess spontaneous strategy use and study behavior. After very brief instruction in the use of category organization during study and recall, children attempted the same items again to practice the trained strategy. Then, after intervening experiences with the spelling and arithmetic tasks, children received a posttest recall task, employing new items to assess the extent to which the trained strategy would be maintained.

Recall performance. The proportion of items recalled varied over trials, as might be expected if a training effect occurs, but more importantly, the nature of change over trails was not the same for all groups. As indicated in Figure 3, there are differences in the extent to which training is maintained at the time of the posttest for groups of children varying in achievement level and teacher characteristics. Children of low or moderate achievement levels, who have teachers who rarely offer strategy suggestions, recall less information at the time of the posttest than do other groups. High achievers, on the other hand, do well regardless of teacher characteristics.

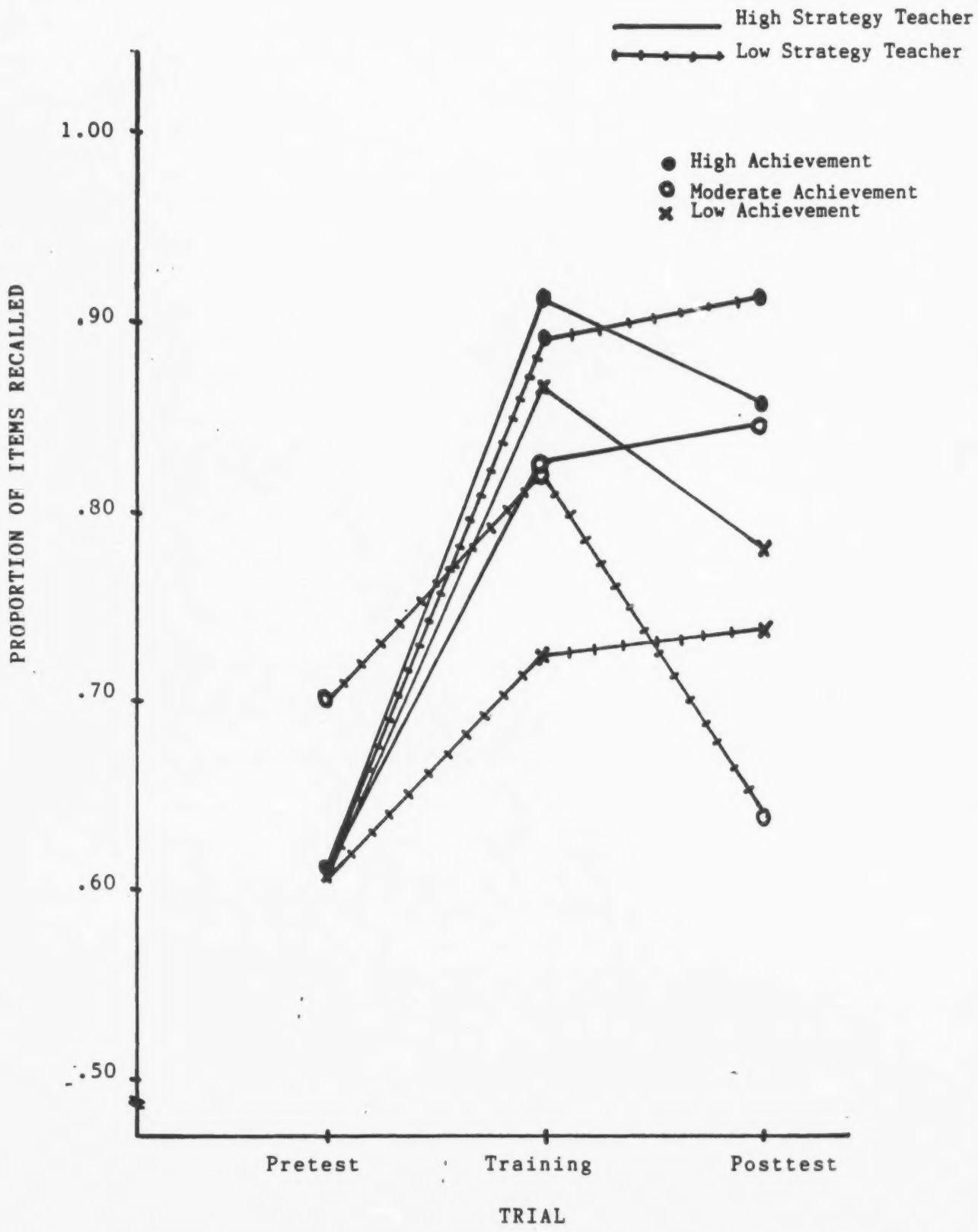

Figure 3. Recall by Children of Three Achievement Levels Whose Teachers Differ in Use of Cognitive Strategy Suggestions.

These findings are supported by an analysis of variance performed on the recall scores, which included grade (3 levels), teacher (high or low in strategy suggestions), and achievement level (high, moderate, low) as between-subjects variables and trials (pretest, training, posttest) as a within-subjects variable. An overall trials effect, $F(2, 92) = 50.43$, $p = .000$, reflected increases in recall from the pretest ($M = .63$) to training ($M = .85$) and posttest ($M = .81$). In a separate analysis, the change from pretest to posttest was shown to be significant, $F(1, 46) = 62.38$, $p = .000$. The interaction of Teacher x Achievement x Trials, $F(4,92) = 3.86$, $p = .006$, is shown in Figure 3, and qualifies both a significant effect of achievement level, $F(2,46) = 3.95$, $p = .026$ and an interaction of Achievement Level x Trials, $F(4, 92)$ 2.58, $p = .042$.

There is also a difference in proportion of items recalled by children of different grade levels, $F(2,46) = 4.14$, $p = .022$, which simply indicates that the effort to equate difficulty level by varying the number of items given to children of different grades was not entirely successful. First graders ($M = .80$) had a somewhat easier task than did second ($M = .75$) or third ($M = .73$) grade children, although no apparent floor or ceiling effects were present at any grade.

Use of Category Organization during Recall. Use of category organization during recall was assessed by means of the RR index of category clustering. Two major findings concerned differences between children from classrooms where teachers varied in strategy suggestions as this classification interacted with achievement level or grade level in determining performance. First, as indicated in Figure 4, low and average achievers from classrooms in which teachers were low in cognitive and strategy suggestions showed less use of category clustering on the posttest. These results closely mirror those shown above for recall scores, suggesting that variations in recall performance are due at least in part to the failure of these two groups to maintain use of the trained strategy. A second pattern of findings concerns differences in use of recall clustering by children of different grade levels whose teachers vary in use of cognitive and strategy suggestions. As indicated in Table 15, first graders showed a greater difference in recall clustering as a function of teacher characteristics than did other grade levels.

An analysis of variance of clustering scores, including grade, teacher, and achievement level as between-subjects variables, and trials as a within-subjects variable supported these interpretations. First, with regard to the information in Figure 4, the analysis showed a dramatic overall increase in category clustering from the pretest ($M = .27$) to the training trial ($M = .85$), which was well maintained on the posttest trial ($M = .81$), $F(2, 92) = 180.14$, $p = .000$. The difference between pretest and posttest was also shown in a

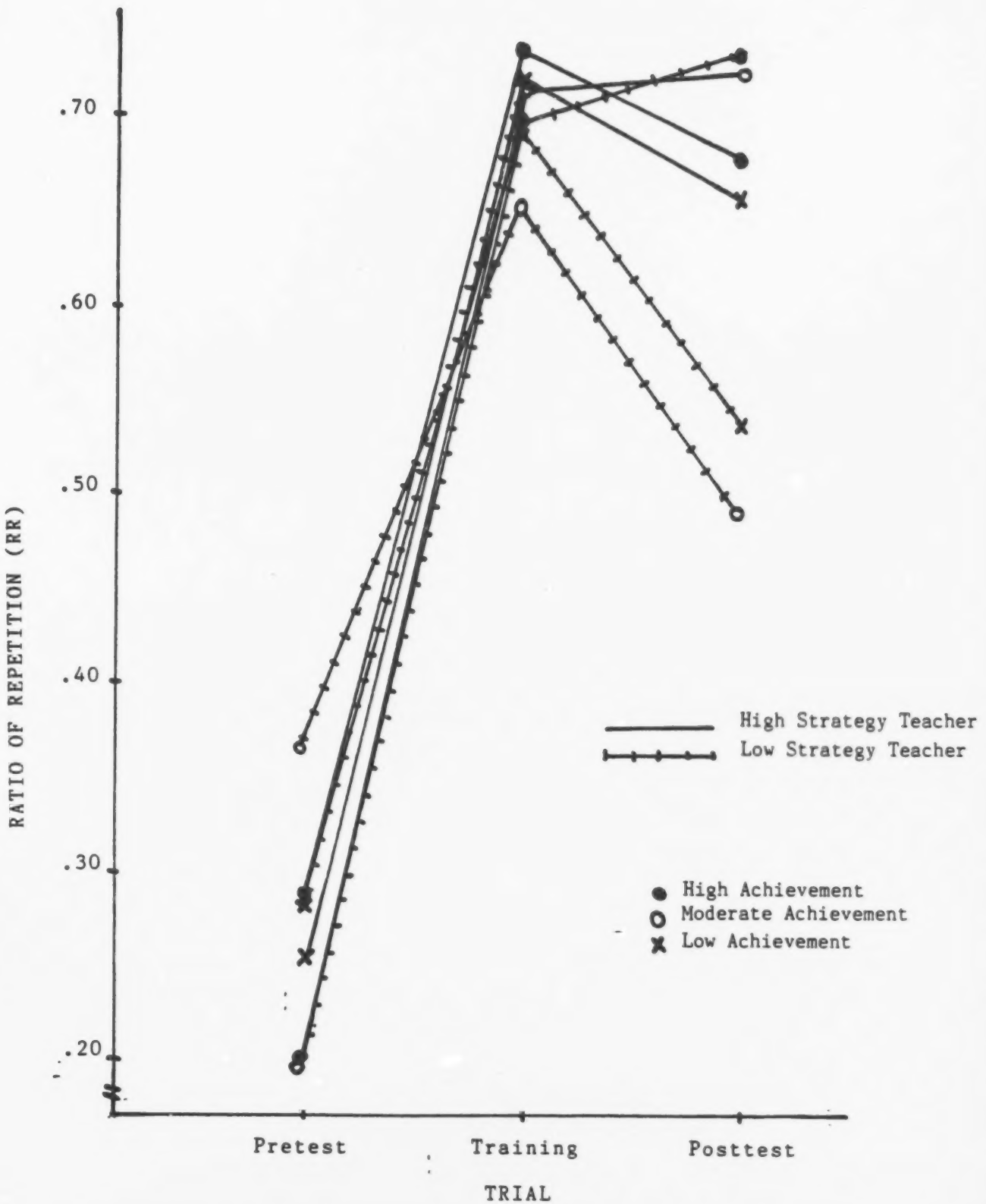

Figure 4. Recall Clustering by Children of Three Achievement Levels Whose Teachers Differ in Use of Cognitive Strategy Suggestions.

Table 15

Category Clustering in Recall (RR Index) Shown by Children of Three Grade Levels Whose Classroom Teachers Vary in Use of Cognitive/Strategy Suggestions

	Grade		
	First (n=23)	Second (n=23)	Third (n=23)
Teacher			
High Strategy	.54	.54	.60
Low Strategy	.44	.58	.62
Total sample	.48	.55	.61

separate analysis to be highly significant, $F(1,46) = 149,75$, $p = .000$. The interaction shown in Figure 4, Teacher x Achievement Level x Trials, $F(4, 92) = 4.36$, $p = .003$, reflects less maintanence of an organizational strategy by low and moderate achievers who have spent the year studying with a teacher who rarely makes strategy suggestions than is the case for high achievers in their classrooms or for any children who have studied with teachers high in strategy suggestions. An almost significant interaction of Grade x Teacher x Achievement Level x Trials, $F(8, 92) = 1.92$, $p = .066$, indicates that this effect is more pronounced at first grade than at other grade levels.

A second finding also concerns grade differences in recall clustering. As indicated in Table 15, there were fairly regular overall increases in clustering across grade level, $F(2,46) = 9.93$, $p = .000$. A more interesting finding is an interaction of grade by teacher, $F(2, 46) = 4.41$, $p = .018$, also shown in Table 15, which indicates that at the first grade level, children whose teachers often made strategy suggestions used category clustering more than did those whose teachers were low in strategy suggestions. An analysis of first grade data only shows a difference between high and low teacher groups, $F(1, 17) = 7.81$, $p = .012$. No such teacher differences appear at either second or third grade.

Category Organization during Study. Categorization of items by category during study was found to reflect the patterns described above for recall and recall clustering. Children of moderate and lower achievement levels from classrooms in which teachers rarely suggested strategies were less likely to sort items by category as they studied during the posttest. This was particularly true for the first graders, whose performance is depicted in Figure 5. Second and third graders, once shown the possibility of grouping by category during training, often did so on both the training and the posttest trials.

These patterns are responsible for an analysis of variance interaction of Grade x Teacher x Achievement Level x Trials, $F(8, 92) = 2.51$, $p = .016$. When first grade data are analyzed separately, an interaction of Teacher x Achievement Level x Trials, $F(4, 34) = 4.03$, $p = .009$, reflects the group differences shown at that grade in Figure 5. Second and third graders, in separate analyses, showed no such interaction. Each of these grades showed only a strong difference over trials in the amount of category sorting carried out during study. For second graders, an increase from pretest ($M = .09$) to the training trial ($M = 1.91$) was shown, which was maintained to a considerable extent on the posttest trial ($M = 1.78$), $F(2,34) = 124.02$, $p = .000$. For the third graders, also, little sorting by category was shown on the pretest ($M = .11$), with a change to complete category grouping by every child in the third grade sample on both the training and the posttest trials (M's for both training and posttest = 2.00),

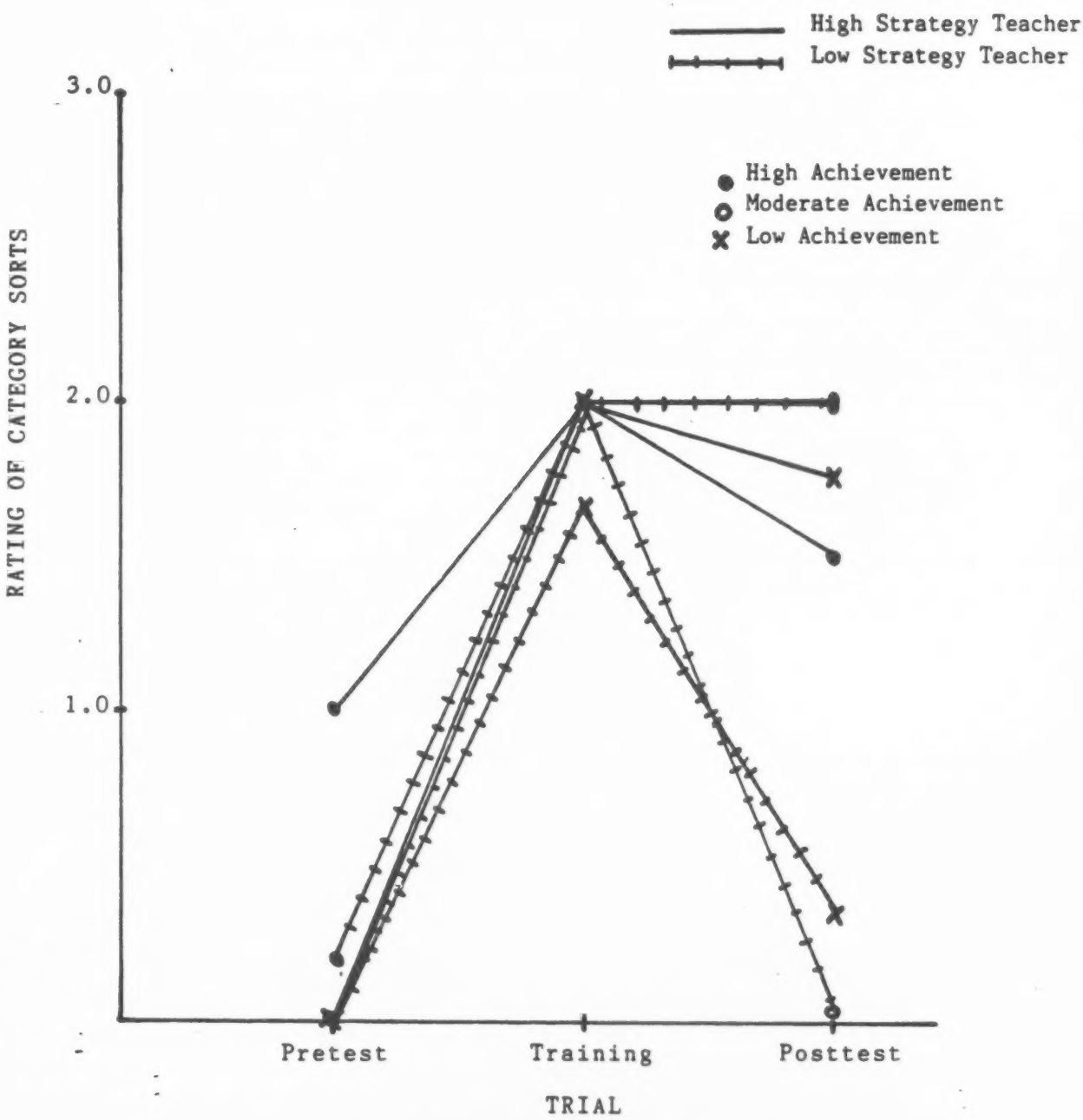

Figure 5. Category Sorting During Study by First-Grade Children Varying in Achievement Level and Teacher Cognitive Strategy Suggestions.

$F(2, 24) = 235.11$, $p = .000$. For second and third graders, no differences in category sorting were shown as a function of teacher characteristics, achievement level, or interactions involving these factors.

Another index of the extent to which children responded to instructions to group items during study was the measure of proportion of all 10-s study intervals in which children moved the pictures. This is a less precise index of category grouping than the experimenter's rating of the extent of categorization in the sort (above), since any sort of moving is coded, whether or not it involved placing items into category sets. Apparently all children learned from the training instruction that they should move pictures, since there was an overall increase from the pretest ($M = .13$) to the training trial ($M = .69$) in the children's tendency to do so, an increase that was well-maintained on the posttest ($M = .62$), $F(2, 92) = 90.54$, $p = .000$. No differences in the tendency to move pictures appeared as a function of grade, teacher characteristics, or achievement level, indicating that children equally often learned from the training instruction that they should move items, even if they didn't learn as consistently to move the items into category sets.

Use of a Self-testing Strategy during Study. Another strategy that was potentially useful in the recall task was a very general strategy, one that is applicable in a wide range of learning situations in which the child must evaluate his or her state of knowledge so as to determine whether the goal of study has been accomplished. On each recall trial, the child was allowed to study as long as he or she wanted, and was instructed to tell the experimenter when study was completed. In this situation, self-testing would be a practical and accurate means by which to tell if adequate study has been carried out. In self-testing, the child essentially engages in a trial test of recall and then checks to see how well he or she did in remembering the items. Training did not focus on this strategy, so it was not reasonable to expect that children would show a change in its use over trials. However, it was possible that training might produce a more general effect on children's performance, perhaps by motivating them to use available strategies to a maximum extent, and that the nature of such a general effect might vary across groups. In order to determine the nature and extent of training effects on self-testing, the child's use of this strategy during 10-s study intervals was examined.

Use of a self-testing strategy was a relatively rare occurrence, observed on only 4.5% of the 10-s study intervals, for the sample as a whole. Older children showed increased use of the strategy, which rarely occurred among first-graders ($M = .002$) or second graders ($M = .03$), but was used to some extent by third graders ($M = .12$), $F(2, 46) = 9.03$, $p = .001$. Self-testing did not increase over trials, indicating that, as anticipated, training was relatively specific in its effects,

not inducing children to engage in the use of a potentially helpful strategy that was not mentioned in training. This conclusion is qualified, however, by a higher order interaction of Grade x Achievement Level x Trials, $F(8\ 92) = 2.65$, $p = .011$. Examination of the mean scores for this interaction indicates that for one group, the third grade high achievers, there was an increase in self-testing from the pretest ($M = .14$) to the training ($M = .24$) and posttest ($M = .18$) trials. For this most mature group, then, training had a more general effect of encouraging effective study apart from the particular activity trained. For all other groups, however, self-testing either decreased or remained relatively constant at a very low level from the pretest to the training and posttest trials.

Other Study Activities. Other study activities that were recorded are two relatively immature strategies, looking at and naming items, that usually are negative related or uncorrelated with recall performance for children of the age levels observed here, and apparently contribute relatively little to the child's learning. Both of these study activities showed a decrease from the pretest to the training and posttest trials, as children adopted more active strategies of moving pictures and studying them in conceptual categories.

Looking decreased from the pretest ($M = .92$) to the training trial ($M = .49$), but then increased slightly from training to posttest ($M = .58$), $F(2, 92) = 60.16$, $p = .000$. Naming of items during study also decreased from a mean of .50 on the pretest trial to .25 at training and .33 on the posttest trial, $F(2\ 92) = 12.80$, $p = .000$. For naming, change over trials varied for children of different achievement levels, $F(4, 92) = 3.34$, $p = .013$, with highest initial use of naming and the greatest decrease over trials shown by children of the lowest achievement level.

Experimenters recorded the length of time that each child spent in study on each recall trial. Training produced an increase in the amount of time children studied, from a mean of 68 s at pretest to a mean of 84 s at training and 85 s at the time of the posttest. Older children studied longer than younger, $F(2, 46) = 6.97$, $p = .002$, with increases from an average of 58 s among first graders to 83 s for second graders and 100 s for third graders. An interaction of Grade x Trials, $F(4, 92) = 3.41$, $p = .012$, is due to a lesser change from pretest to training for the second grade group than for others, a finding of no particular value in accounting for performance findings.

Children's Metacognitions about Study and Recall Strategies. Children were given several interview questions to assess their metacognitions about category organization as a study and recall strategy. First, on each of the three recall trials, children's descriptions of how they had studied

the items were coded according to whether or not categories were mentioned. Analysis of these scores indicated that categories were mentioned more often during training (M = .83) and at the posttest (M = .73) than on the pretest trial (M = .11), indicating a greater awareness of the potential usefulness of the category structure of the lists following the brief training procedure, $F(2, 92) = 70.53$, $p = .000$. There is also a trend for children of high strategy teachers to show greater mention of categories following posttest recall than do children of low strategy teachers. This finding appears as a trend in the analysis of variance (p = .091). When the posttest scores are analyzed separately, the teacher difference is significant, $F(1, 46) = 9.10$, $p = .004$. No differences between groups of children from teachers varying in strategy suggestions appeared for either the pretest or the training trial. These findings are consistent with the differences among children of high and low strategy teachers on recall clustering measures, described earlier. There was a trend (p = .078) for increased category mention with increasing grade, as might be expected as a function of older children's greater verbal skills and metacognitive understanding.

Children were asked at the end of both the pretest and posttest to describe what they had done during recall to remember the pictures, and answers were coded for mention of organizational strategies. Analyses indicated that children were more likely to mention organization as a way to remember when queried following the posttest (M = .94) than they had been in the pretest (M = .28), $F(1, 46) = 23.68$, $p = .000$. This was particularly true for high and moderate achievement level children; low achievers showed considerably less increase from pretest to posttest than did other groups. An interaction of Achievement Level x Trials, $F(2, 46) = 4.46$, p = .017, highlights this pattern. Finally, analysis indicated that third grade children (M = .86) were more likely to mention organization in their responses than were second (M = .57) or first graders (M = .46), $F(2, 46) = 3.37$, $p = .043$.

At the end of the posttest, children were asked to describe the training instruction, in order to see if they had learned about the use of category organization as a strategy for recall. Analysis indicated variation in recollection of the training as a function of both teacher characteristics and children's achievement level. Children whose teachers were high in use of cognitive strategy suggestions in the classroom were more likely to verbalize an accurate recollection of the training instruction (M = .95) than were those whose teachers rarely offered strategy instructions (M = .65), $F(1, 46)$ = 9.10, $p = .004$. Low achievers showed less accurate recollections of training (M = .68) than did moderate (M = .95) or high achievers (M = .83), $F(2, 46) = 3.41$, $p = .041$.

Finally, children's responses to questions about study were examined in order to determine whether children mentioned

using self-testing or some other organized system in determining when they should complete study. Although no instructions about how to determine when to stop studying were given during training, children showed an increasing tendency from the pretest (M = .58) to the posttest (M = .83) to mention some procedure for determining when to complete study, $F(1, 46) = 8.57$, $p = .005$. There was also an increasing tendency with grade level to describe the use of a procedure for deciding when to complete study, $F(2,46) = 5.94$, $p = .005$, which is consistent both with the grade differences seen in the use of the self-testing strategy during recall and with the generally increased metacognitive skill of children across grade levels.

Spelling Task

Children's accuracy in spelling the words was evaluated by means of two scores: the proportion of words presented that were recalled correctly, and the proportion of letters within words that were recalled in the correct positions. Neither of the measures showed differences between grade levels, achievement groups, or groups of children whose teachers varied in use of cognitive strategy suggestions. Overall, children recalled .18 of the words correctly (SD = .27) and recalled .61 of the letters in correct positions (SD = .66). Since no differences in performance were obtained, efforts to identify group differences in study behaviors or metacognitions are of less interest than might otherwise have been the case. Nonetheless, comparisons of groups on several variables measuring study activity and children's concepts concerning study of spelling were made.

Examination of the kinds of behaviors shown during study indicated that teacher characteristics had little influence on the kind of study that children used. There were differences among grade levels in the kinds of study behaviors most often observed, with increases over grade in the use of self-testing and decreases in the proportion of time that children spent writing the words during study, as shown in Table 16. As indicated there, children as a group used looking as their most frequent strategy and also used naming (verbalizing names of letters) as a frequent activity at each grade level.

An analysis of variance of the four behaviors coded during study, including grade, teacher characteristics, and achievement level as between-subjects variables, and behavior as a within-subjects variable, yielded effects that support these interpretations. A significant effect of behavior, $F(3,138) = 24.05$, $p = .000$, reflects the considerable variation of use of the various study activities. An interaction of grade with behavior, $F(6,138) = 3.18$, $p = .006$, indicates differential use of the four study behaviors at different grade levels. When each study behavior was analyzed separately, only self-testing showed a significant difference between grade levels, $F(2,46) = 11.93$, $p = .000$ and also, a

Table 16

Behaviors Shown by Children of Three Grade Levels While Studying Spelling Words

	Grade			
	1	2	3	Total Sample
Study Behavior				
Looking	.71*	.86	.77	.78
Naming	.46	.54	.45	.49
Writing	.48	.36	.22	.36
Self-testing	.11	.12	.42	.20

*Each value represents the mean proportion of study intervals in which study behavior was observed.

trend for an interaction of grade with achievement level, $F(4,46) = 2.42$, $p = .062$. This interaction reflects the very high use of self-testing ($M = .70$) by third grade high achievers, a group that also employed self-testing to a notable extent in the free recall task described above. There were no group differences in amount of time spent studying, with children averaging 91.4 s in preparation for recall.

Children's responses to interview questions about how they had studied for recall and how they decided when to end study were examined for descriptions of self-testing activity during study. An increase in such descriptions was seen over grade level, increasing from first ($M = .70$) and second ($M = .75$) to the third grade ($M = .89$), $F(2,46) = 7.47$, $p = .002$. Significant interactions of grade with achievement level ($p = .006$) and grade with teacher characteristics ($p = .028$) are not readily interpretable.

Children's metacognitions about how to study for spelling lessons in school were evaluated by considering the likelihood that children would describe various study activities, including self-testing, rote methods, use of spelling rules, and use of semantic elaboration as ways of studying spelling words. As indicated in Table 17, children were more likely to suggest rote strategies or self-testing than they were to mention the use of rules for spelling or semantic elaboration of letter relationships, $F(3,138) = 41.58$, $p = .000$. These patterns varied to some extent across grade levels, as indicated in Table 17, where it can be seen that the strategies most often described by first graders are rote methods, while second graders mention rote methods and self-testing, and also describe the use of semantic elaboration more often than do other age groups. Third graders are most likely to describe self-testing, although they also mention rote methods to a considerable extent. These patterns are reflected in an interaction of Grade x Response, $F(6,138) = 4.06$, $p = .001$. Analyses of each strategy separately indicates significant grade differences in the mention of both self-testing ($F(2,46) = 4.30$, $p = .019$) and elaboration ($F(2,46) = 6.38$, $p = .004$). Higher order interactions of Grade x Achievement Level x Response ($p = .012$) and Teacher Characteristics x Achievement Level x Response ($p = .035$) are difficult to interpret and will not be considered further.

Arithmetic Task

Analyses of children's performance on the arithmetic problems given as the first part of the task indicated that the number of problems attempted increased with grade level, $F(2,46) = 59.77$, $p = .000$, with first graders attempting an average of 7.34 problems, second graders attempting 9.39, and third graders attempting 11.28 of the 12 problems presented. This is reasonable, in that children of higher grades should greater expertise in arithmetic and be able to deal with more difficult problems. A trend for a grade effect was seen for

Table 17

Development of Metacognitions Concerning Spelling: Mention of Ways of Studying by Children of Three Grade Levels

	Grade			
	1	2	3	Total Sample
Response				
Rote Methods	.78	.91	.83	.84
Self-Testing	.48	.74	1.17	.77
Semantic Elaboration	.17	.35	.00	.19
Rules for Spelling	.04	.09	.17	.09

the proportion of problems that children completed correctly of those that were attempted, $F(2,46) = 2.97$, $p = .061$. First-graders solved less of the problems attempted ($M = .60$) than did second ($M = .68$) or third grade children ($M = .73$). An interaction of grade with teacher characteristic, $F(2,46) = 3.73$, $p = .031$, reflected a difference among first graders between children whose teachers were low in strategy use ($M = .52$) and children whose teachers were high in strategy use ($M = .69$) in the proportion of problems completed correctly, a difference that did not appear at higher grades.

A question of particular interest concerned the kind of strategies that children might use in attempting to solve the problems. Five solution strategies that children were observed to use were coded and analyzed in an analysis of variance involving grade, achievement level, and teacher characteristics as between-subjects variables, and correctness of response and strategy as within-subjects variables. Use of the several strategies varied considerably, $F(4,184) = 43.17$, $p = .000$. The most frequently observed strategy (on 49% of all problems attempted) was elaboration of the representation through the use of manipulatives or fingers, which occurred when children used some kind of external aid or their fingers to aid solution of the problem. Counting as a strategy was recorded (on 35% of all problems attempted) when children counted aloud, with or without any visible referent, as a way to solve the problem. Carrying out arithmetic operations was recorded for 18% of all problems attempted and occurred when children used traditional means of solving the problem, usually by using paper and pencil or talking aloud about carrying out specified arithmetic operations or numbers. This often was indicated in children's booklets by marks for carrying or borrowing or doing steps in long division, etc. Elaboration of the representation through the use of symbolic processes was the least frequently observed strategy (on 2.2% of all problems attempted) and was defined as using an arithmetic relationship to simplify or break down the problem into easier steps for solution. When children showed no visible strategy use and no sign of carrying out traditional arithmetic operations, retrieval was recorded (on 32% of all problems attempted).

The strategies children used on each problem were related to whether or not the problem was solved correctly, $F(4,184) = 35.71$, $p = .000$, in ways that varied both with grade (Figures 6 and 7), $F(8,184) = 2.34$, $p = .021$ and achievement levels $F(8,184) = 2.14$, $p = .034$. In general, children increased their use of manipulatives, counting, and arithmetic operations and decreased their use of retrieval on the more difficult problems (the incorrectly answered ones). Children whose teachers often made strategy suggestions showed a different pattern of strategy use than did those whose teachers seldom suggested cognitive or strategic activity in the classroom, $F(4,184) = 8.86$, $p = .000$. Grade, achievement level, and teacher-defined group differences were

further investigated by carrying out analyses separately on data for each of the strategies. Manipulatives were employed more often by children whose teachers were low in strategy suggestions, $F(1,46) = 15.56$, $p = .000$ and were used by these children particularly on difficult problems, $F(1,46) = 4.66$, $p = .036$. First-graders were more likely than other groups to use manipulatives on problems that they answered correctly, while all age groups were likely to use manipulatives on difficult problems, $F(2,46) = 3.42$, $p = .041$, as can be seen in Figures 6 and 7. Counting was shown more often by children whose teachers were low in strategy suggestions ($M = .43$) than by those whose teachers often employed cognitive and strategy suggestions ($M = .29$), $F(1,46) = 6.07$, $p = .018$. Arithmetic operations were used more often by third graders, as can be seen in Figures 6 and 7, than by younger groups, $F(2,46) = 4.74$, $p = .013$. The use of symbolic representation, which was low at all grade levels, showed no differences attributable to grade, achievement level, or teacher characteristics. Retrieval was seen more often with children whose teachers were high in strategy suggestions ($M = .38$) than with children whose teachers were low in such suggestions ($M = .23$), $F(1,46) = 8.18$, $p = .006$. Children of moderate or high achievement levels were more likely to use retrieval on problems answered correctly than were low achievers, and also, were less likely than low achievers to use retrieval on problems answered incorrectly, $F(2,46) = 4.63$, $p = .015$. Use of retrieval for correct and incorrect problems also varied with grade level, $F(2,46) = 4.24$, $p = .020$, as indicated in Figures 6 and 7, where it can be seen that second and third graders differentiate the use of retrieval to a greater extent for easy and difficult problems than first graders are likely to do, perhaps showing a greater ability to regulate strategic behavior according to the demands of a problem. The finding of lesser use of manipulatives and counting strategies and the greater use of retrieval by children whose teachers are high in strategy suggestions relatively to those whose teachers are low in this classroom activity is contrary to expectations. It may reflect the slightly higher mathematics achievement of children from classrooms of teachers high in strategy use. If these children are more capable with mathematics, they may be able to deal adequately with problems by using a retrieval procedure rather than a more overt, external strategy or representational process.

When children were asked to check their work, only 7.8% of all errors made were detected and corrected; older students tended to be more likely to correct their errors ($p = .094$) and were more systematic in checking their work, $F(2,46) = 12.69$, $p = .000$, than were younger. No differences between achievement levels or teacher-defined groups were seen.

Analysis of the types of errors children made revealed that approximately two-thirds of all errors were a result of incorrect mathematical procedures or operations, while the remaining errors involved incorrect mathematical facts,

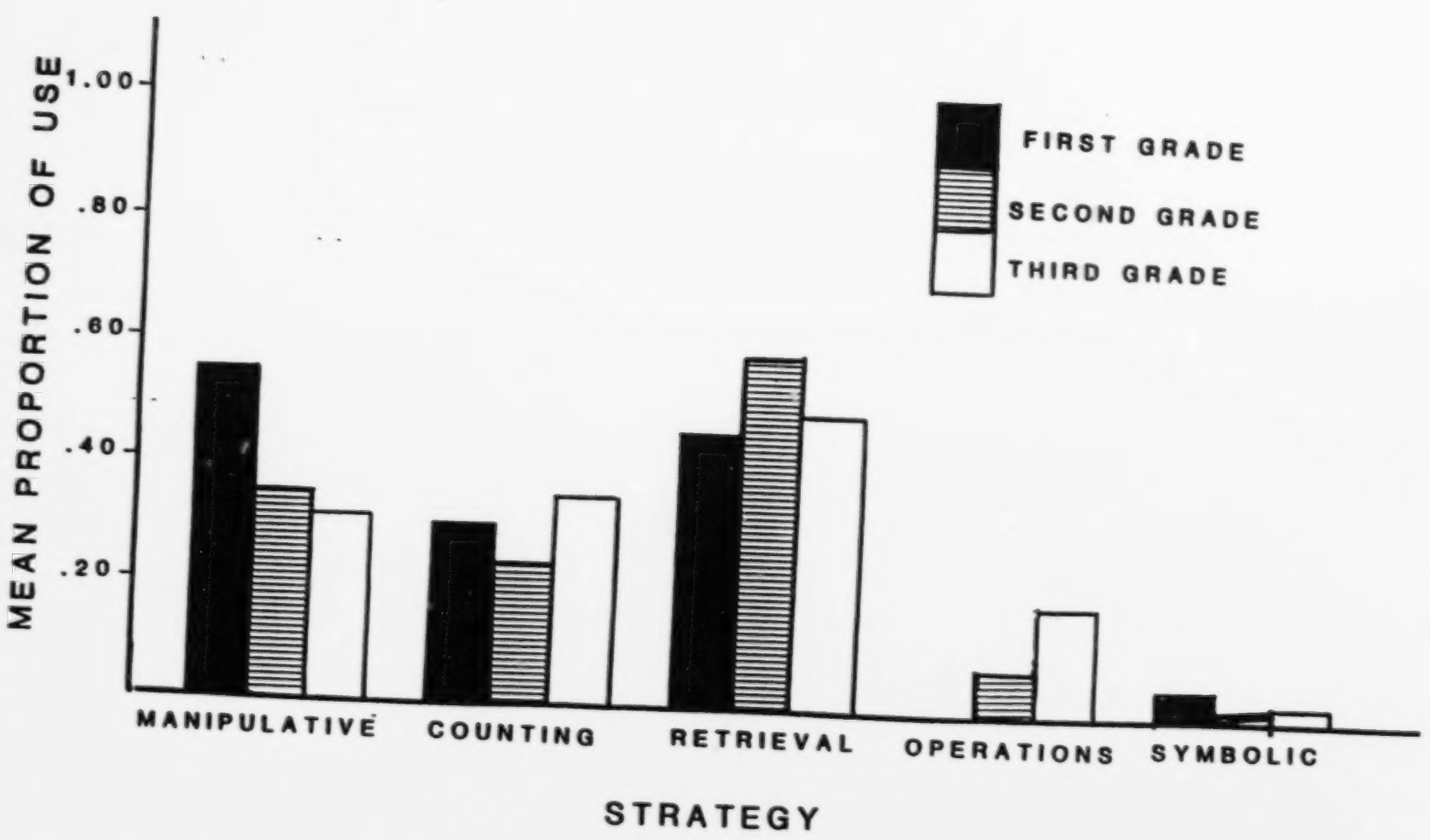

Figure 6. Mean proportion of each strategy's use on problems answered correctly by children at three grade levels.

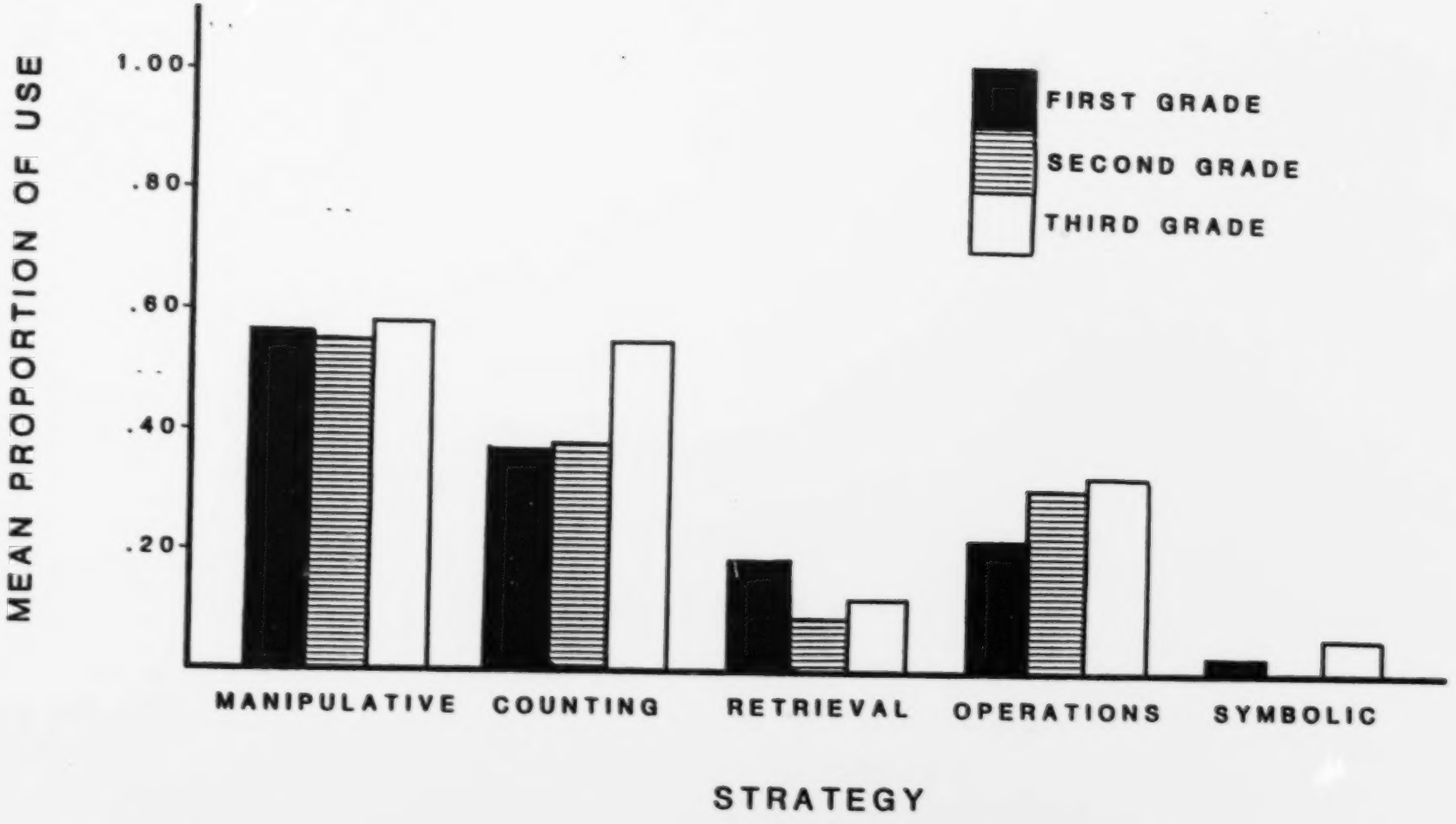

Figure 7. Mean proportion of each strategy's use on problems answered incorrectly by children at three grade levels.

$F(1,46) = 26.26$, $p = .000$. Inspection of Figure 8 reveals that first-grade students made more procedural and less factual errors than second- and third-grade students, $F(2,46) = 8.12$, $p = .001$. This result is probably due to the first-grade students' lack of knowledge of more advanced arithmetic procedures and their use of manipulatives to ensure the accuracy of simple addition and subtraction facts.

Also investigated in the present study was children's metaknowledge for solving arithmetic problems, a topic that has received little attention in past work on the development of number concepts. In order to learn how children conceptualize the logic of simple arithmetic problems, an exploratory interview was conducted and children's verbatim responses were recorded. In one of the questions, children were asked to look at answers to problems previously solved and to prove to another that the answers given were really the correct ones. The suggested use of external aids or manipulatives was the most frequent response to how one could prove that an answer to an arithmetic problem was correct, $F(2,92) = 16.82$, $p = .000$, as indicated in Table 18. Responses varied with grade level, $F(4,92) = 2.63$, $p = .039$, with third-grade children suggesting the use of arithmetic operations more often and the use of external aids less often than the younger students did. Nonstrategic responses, such as asking teacher for the correct answer or reworking the problem, were often suggested, especially by the oldest group.

In a second metacognitive task, children were asked to explain to a hypothetical younger child the logic of an arithmetic operation. Although many children required some prompts before providing a satisfactory response, the students generally were quite successful in explaining the logic of an addition operation. No group differences related to grade, achievement level, or teacher characteristics were found in children's ability to represent the concept of addition appropriately.

The third topic queried in the metacognitive interview concerned children's views of how to deal with difficult arithmetic problems. The most common responses referred to the use of some kind of manipulative to represent the problem externally. Also quite frequent were responses concerning the use of arithmetic operations or seeking help from another person. Infrequent responses described the use of rote methods or aids designed to influence memory, self-checking activities, and practice. Differences in category use for the entire sample, $F(6,276) = 33.56$, $p = .000$, are shown in Table 19. Use of the various response categories varied with achievement level, also indicated in Table 19. Low achieving students suggested the use of logically related numerical operations as a means of dealing with difficult problems less often than average and high achieving students did. Low achieving students were more likely than average and high achieving students to suggest seeking the assistance of other

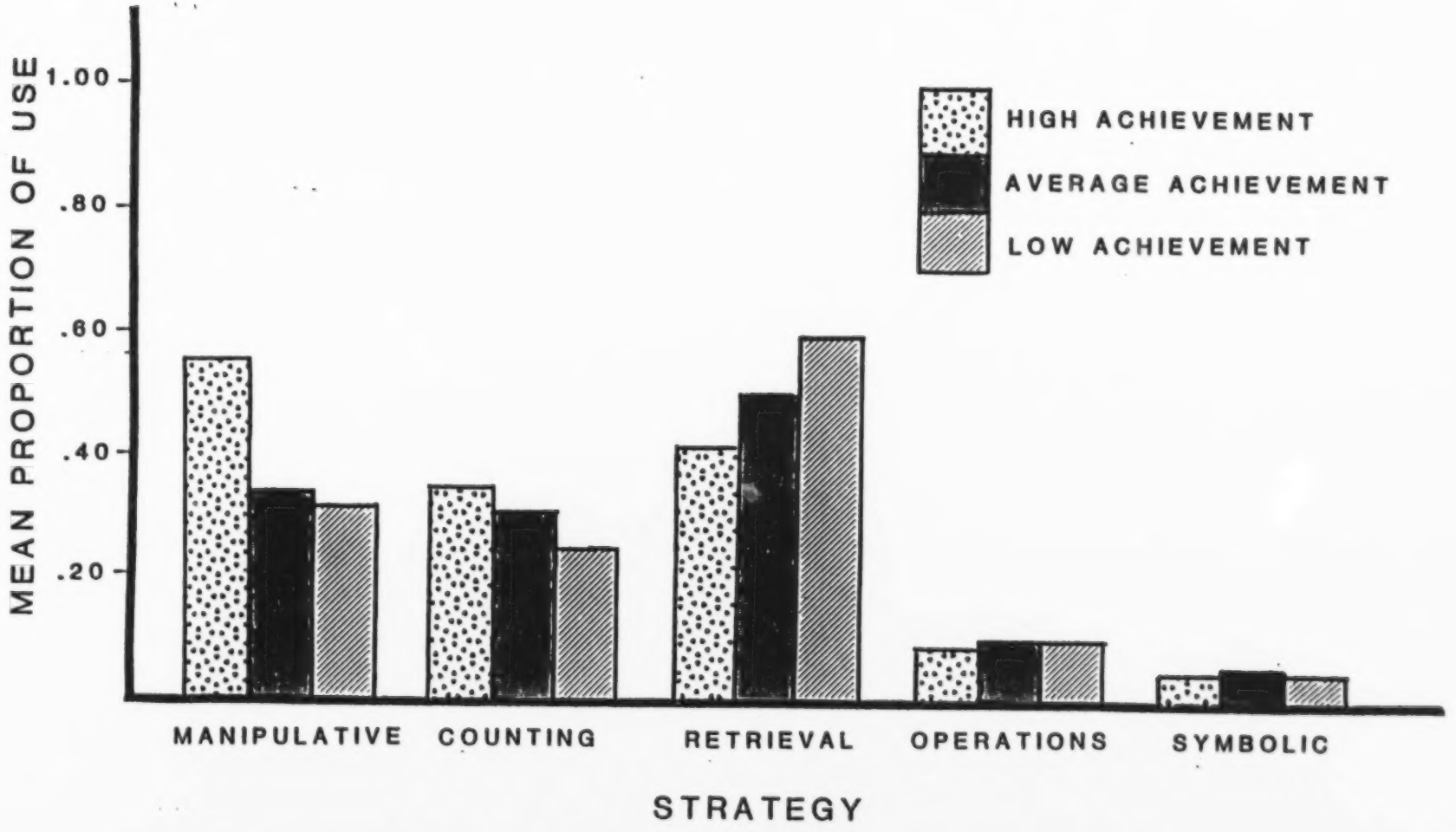

FIGURE 8. MEAN PROPORTION OF EACH STRATEGY'S USE ON PROBLEMS ANSWERED CORRECTLY BY CHILDREN AT THREE ACHIEVEMENT LEVELS.

Table 18

Answers Given by Children of Three Grade Levels to Questions about How to Prove that Answers to Arithmetic Problems are Correct

Answer	Grade 1	Grade 2	Grade 3	Total Sample
Use manipulative to represent problem	.65	.83	.44	.66
Use mathematical operations to prove answer	.09	.13	.28	.16
Other methods	.26	.39	.67	.42

Table 19

Answers Given by Children of Three Grade Levels to Question About How to Deal with Difficult Arithmetic Problems

Answer	Group			Total Sample
	Grade 1	Grade 2	Grade 3	
Use external aids to solve problem	.74	.81	.75	.77
Use arithmetic operations	.05	.33	.29	.23
Get help from another person	.42	.10	.17	.22
Engage in rote memory exercises	.16	.14	0	.09
Practice doing problems	.05	.14	.04	.08
Use external aids for memory (e.g., flashcards)	.05	.10	0	.05
Does self-checking when working problems	0	0	.08	.03

persons (e.g., the teacher) in dealing with difficult arithmetic problems.

In summary, the present study investigated first-, second-, and third-grade children's strategic behavior and metaknowledge for solving written arithmetic problems. Children were observed to be strategic in their approach to solving the arithmetic problems presented, and as early as the first grade varied their strategic approach based on the difficulty level of the problem. The use of external aids or manipulatives was appreciated by children at all three grade levels, as evident in both their approach to problems and in their responses to the metaknowledge interview. Students rarely attempted to break problems down into easier steps for solution. Older and higher achieving students revealed a better understanding of the logic inherent in mathematical operations in their responses to the interview questions than did younger or lower achieving children.

Discussion

A primary goal of the present study was to determine if there were differences in the memory task performance of children whose teachers varied in the extent to which they suggested cognitive strategy suggestions in the classroom. Analyses of performance on three tasks indicated that differences between groups of children whose teachers varied in this way appeared primarily in their reactions to a training procedure carried out on a somewhat novel memory task. On this task, which involved free recall of category items, children of moderate and low achievement levels showed differences related to teacher characteristics. Children of high achievement levels generally were positively affected by a brief training procedure, maintaining strategy use on a posttest trial with new materials. Among average and low achievers, the degree to which maintenance of the trained strategy was shown was related to teacher characteristics. In particular, average and low achievers whose teachers were high in strategy suggestions in the classroom were more likely to use organization during recall, recall more items, and organize items to a greater extent during study (especially at first grade). In general, children whose teachers were high in strategy suggestions showed somewhat greater ability to articulate verbally the features of the organizational strategy that they were taught and were better able to recollect the essential features of the category training procedure when queried at the end of the session than were children who had spent the school year with a teacher who rarely made strategy suggestions. Thus, a pattern of varying benefit of training appears on several measures that index use of category grouping as a study/recall strategy, lending strength to a conclusion that teacher characteristics influence children's reaction to training.

There were several indications that first graders were

particularly affected by their teachers' use of strategy suggestions. First graders showed greater relationships between teacher characteristics and both the likelihood of sorting items by category during study on the posttest trial and the tendency to use category clustering in recall. First graders have had less total exposure to teachers, and might be particularly affected by the extent of their teacher's emphasis on cognitive processing strategies. It is also likely that first graders are more dependent upon the teacher as a source of information about how to study than older children are, since their own limited metamemory and self-regulatory skills make them less able to invent and accurately evaluate their own ways of learning.

The brief training instruction given in free recall was generally quite effective in promoting strategy use for these young children. Several components of the instruction were important in creating this effect: children were encouraged to participate actively in sorting items by category during the instruction period, they received a practice trial on which they were prompted to use the strategy, training instructions directly connected sorting during study with ordering of items by category during recall and suggested a retrieval strategy based on category organization, and finally, children were given an explicit rationale about the usefulness of the strategy in improving performance as well as feedback about their success in using it. Thus, training was both explicit and detailed, requiring the child to be active in using the trained procedure, and providing a rationale for it. Considerable maintenance was shown on the posttest, although the study did not provide a strong test of maintenance, since the posttest was given in the same session, by the same experimenter who had provided training, and was separated from training only by two other brief tasks. Thus, it is not surprising that children maintained the strategy as well as they did, though it is, perhaps, surprising that average and low achievers with low strategy teachers did NOT maintain the strategy any better than they did.

Other study strategies were also recorded, in order to see if training would have an effect on their use. The child's tendency to move pictures was affected very strongly by training, since instruction directly included mention of such activity. No instructions were given about the use of three other strategies observed during free recall study. For looking and naming, there was a decrease in use over trials for the sample as a whole, as children came to engage in other strategies that replaced these less mature ones. Self-testing occurred much less often than other study strategies, and in fact, was relatively non-existent in the youngest group. With age, there was an increase in both observed self-testing and the child's tendency to describe the use of a self-testing strategy during study, on both the free recall and the spelling tasks. Generally, training did not have any effect on the child's use of self-testing during the recall task.

However, for one group of children, a training effect did appear: for the most developmentally mature group in the sample, the high achievers at the third grade level, self-testing in preparation for recall increased from the pretest to later trials. The training procedure may have had a generally motivating effect for these children, so that they not only used the trained strategy, but were able to go beyond training to generate another useful and effective strategy. The same group of children showed high use of self-testing during the spelling task, which might reflect a carry-over effect or simply a greater propensity to employ this strategy.

An activity that one might consider to be related to self-testing in the spelling and recall tasks is that of self-checking, assessed in the arithmetic task when students were told to go back and "check" their work. An increase with grade level in the effectiveness with which children could carry out this strategy corresponds well with age changes in the use of self-testing on the other tasks. However, findings imply that self-checking is a more complex and difficult procedure, in that children were seldom able to use this technique to improve their performance in the arithmetic task. Less than 8% of all errors were identified and corrected when children were instructed to check their work. As indicated in the first study, teachers expect even very young children to be able to carry out self-checking activities, an expectation that may be unrealistic at these early grades.

Few teacher differences appeared for the arithmetic and spelling tasks, which are more similar to tasks that children typically encounter in school. Children whose teachers are high in strategy suggestions showed somewhat greater competence on the arithmetic problems, completing correctly a greater proportion of items attempted, and using retrieval rather than manipulatives or counting strategies in the task. These differences may be related to the somewhat higher mathematics achievement of children whose teachers were high in strategy use. In spelling, no differences were shown between groups varying in teacher characteristics. Perhaps for tasks regularly encountered in school, children are able to develop effective strategies through assistance from a variety of sources: parents, other teachers, individual practice, or even through examples provided by other children, so that the teacher's influence on performance is only one of many influences. Or, it may be that these well-practiced tasks are ones in which even a relatively low strategy teacher will ultimately suggest enough appropriate strategic approaches to enable the child to deal effectively with the tasks.

The spelling task was unique in not only allowing us to examine performance and strategy use during study, but also, in providing an indication of the children's metacognitions about spelling. Observations indicated that developmental changes in study methods appear over these grades: the first-

graders relied primarily on a simple strategy of looking at items, with some use of naming and writing activities. At second grade, children were even more likely to use these strategies, and like first graders, did not employ self-testing. At the third grade level, although looking and naming are still frequent, children now also employ self-testing. Older children may be better able to coordinate a variety of task-appropriate strategies for spelling, since they show more use of the entire set of strategies than is true at earlier grades. Their use of writing while looking at the words is less than that shown by younger groups, probably because they have incorporated writing activity into self-testing strategies. Children's metacognitions about spelling are consistent with the behavioral findings, in that young children frequently mention rote methods such as looking, naming or writing items, while older children are more likely to mention the more active self-testing strategy, a strategy that has been suggested recently in recommendations for ways to remediate children's spelling disabilities (Ganschow, 1983). Children rarely describe the use of rules for spelling as a way of dealing with spelling tasks, a finding that is surprising in light of the content of school spelling lessons, which usually include consideration of rules for relating word sounds to their representations in written language and also in light of research on spelling, in which children are shown to adopt rules based on complex systems for relating phonemes and graphemes (e.g., Barron, Treiman, Wilf, & Kellman, 1980; Marsh, Desberg, & Cooper, 1977; Marsh, Friedman, Welch, & Desberg, 1980).

The arithmetic task was also used to investigate strategy use and metacognitive activity. Viewing children's mathematical performance from an information-processing perspective is a relatively new approach, and recent research in this area has been directed toward understanding the development of computational skills and problem-solving strategies as well as investigating the processing demands for individual arithmetic tasks. For example, Siegler and Robinson (1982) recently investigated the development of numerical understanding among preschool children. They found that some children as young as three years of age were able to count successfully, compare numbers, and do simple arithmetic problems. Findings of the present study indicated that these somewhat older children are highly strategic in their approach to arithmetic problems, using manipulatives, counting, or arithmetic operations appropriately depending upon the difficulty level of the problems encountered. In several existing theories of mathematical competence (Ashcraft, 1982; Siegler & Shrager, 1983), the assumption is made that individuals first attempt to retrieve an answer from memory. Only when retrieval fails are strategies invoked to compute the answer. Siegler and Shrager (1983) suggest a three-phase process in arithmetic problem solving, moving from retrieval to elaborations of the problem representations to using traditional arithmetic operations to solve a problem. In the

present study, children showed changes in strategy use dependent upon problem difficulty that in general lend support to this model.

Older and high-achieving students revealed a better understanding of the logic inherent in mathematics in their responses to the interview questions than did younger or lower achieving students. In proving answers correct or in dealing with difficult problems, older children were more likely than younger to mention mathematical operations (e.g., use addition to check subtraction), reflecting their superior understanding of the relationships between different mathematical operations. They were also less likely to rely on uncertain sources, such as another person, and less likely to rely on rote learning or practice activities as ways of dealing with arithmetic problems than were younger children.

In summary, children showed variations in strategy use in school-related tasks as a function of grade level and, in some cases, with level of achievement, as well. However, little variation as a function of teacher characteristics was shown on either the arithmetic or the spelling task. When children were required to learn a novel strategy, high achievers were able to do so in all cases. Moderate and low achievers, however, were able to benefit by a brief strategy training to a greater extent if their classroom teacher was one who regularly suggested strategies for studying than if their teacher rarely did so. A high strategy teacher, then, can be influential in enabling children to learn new strategies. Such teachers may be affecting children's metacognitive learning capabilities, as well as their task performance, when they engage in frequent strategy suggestions in the classroom.

Chapter 4. Development and Evaluation of a Workshop for Teachers

As an outcome of the work reported above, the research team undertook the development of a workshop that could be given to elementary school teachers, which is summarized in a written narrative presented below in Chapter 5. The workshop incorporated information on memory development, strategy use, and metacognitive skills of children from kindergarten through the higher elementary school years, and also, summarized information obtained from the observational and questionnaire measures and the interviews with teachers conducted as part of the first study.

Several presentations of the workshop were made, and a videotaped presentation of it is available from the authors. Participating teachers were asked to complete questionnaires to assess their knowledge of memory development before and after attending the workshop and to obtain their evaluations of the content and structure of the workshop. Information derived from these measures is presented below.

Method

Subjects

Workshop participants were 64 teachers and administrators from public schools in the greater New Orleans area. A total of 53 teachers and administrators took part in workshops given at two suburban schools. An additional 11 individuals attended a workshop presented at Tulane University. Participants were 20 teachers of grades K-1, 18 teachers of grades 2-3, 16 teachers of grades 4-6, 3 special education teachers, and 7 administrators. Most teachers reported that the children in their classrooms were of mixed (75%) or average (15%) ability levels. Information forms completed by 63 participants indicated that they had taught for an average of 13.3 years (SD = 6.5), for 8.4 years (SD = 6.0) at the grade level they were teaching at the time of the workshop. Most teachers had completed college majors in elementary education (78.7%), while others had studied early childhood education (8.2%), special education (3.3%), or other areas (9.8%). Nearly half of the sample had completed some graduate work, including 29% who had earned an advanced college degree.

Materials

A videotape was prepared to demonstrate ways in which children typically study in memory tasks. The first part of the tape showed two children carrying out a free recall task. The first child was a 7-year-old, who showed typically immature study behaviors (looking at and naming pictures during a very brief study period) and limited recall. The

second child was a 10-year-old who showed mature and effective study behaviors (grouping and studying items by category, self-testing recall readiness) and excellent recall of the list items. This part of the tape was used during presentation to demonstrate the contrast between children of two developmental levels, and to show the varied effectiveness of different strategies in promoting learning. The second part of the tape demonstrated a training procedure, in which a child was taught to use a self-testing strategy to evaluate his knowledge state during study. The tape showed that with the use of this study strategy, the child was able to recall a substantial number of list items.

An outline of the workshop was provided for each participant to use during workshop presentation. The outline is given on the first pages of Chapter 5, below. A copy of the complete workshop narrative was given to each participant at the end of the session.

A 12-item questionnaire was prepared to assess teachers' understanding of concepts emphasized in the workshop. This questionnaire is shown in Table 20. Items were selected to tap teachers' knowledge of developmental changes in memory and metamemory skills, their awareness of the effects and limitations of memory training procedures, their views of children's motivation, and their evaluations of particular memory strategies. A second questionnaire (Table 21) was used to obtain teachers' evaluations of the workshop content (interest level and value of the material presented, applicability of information in the classroom, and specific examples of such applications) and the structure of the presentation (materials used during the workshop, degree of emphasis that various topics should receive).

Procedure

The workshop lasted approximately 2 hours. For the first 90 minutes, four members of the research team made presentations on topics including memory development, strategies, metamemory, and self-regulation of memory efforts. This information was based on the literature on memory development and training. Next, information concerning the strategy suggestions we saw teachers use in the classroom was given, and the value of these strategies for children's learning was discussed. A presentation of information on effective training of memory skills was made next, focusing on training methods that have been shown to produce maintenance and generalization of a trained strategy. Training of metacognitive and self-regulatory skills was discussed, with emphasis on helping children develop the abilities to generate, evaluate, and regulate their own memory efforts. Encouragement of children's motivation for task performance

Table 20

Questionnaire Used to Assess Teachers' Memory Concepts Before and After Workshop

1. Self-testing as a study strategy is used often by both younger and older children. T F

2. Memory training studies have generally been successful in
   a) teaching immature learners to transfer the learned strategy to new situations.
   b) improving the immature learner's immediate memory task performance.
   c) getting children to continue using the learned strategy.
   d) all of the above.

3. Children's motivation can be fostered by
   a) praise and encouragement.
   b) competition between students.
   c) using material having intrinsic interest to the child.
   d) using games as a learning activity.
   e) all of the above.

4. Repetition of facts and attributing meaning to the information to be learned are equally effective study strategies. T F

5. Research on the "finger counting strategy" concludes that
   a) finger counting should be discouraged because young children will become too dependent on it.
   b) finger counting should be discouraged because rote memorization of math facts in young children is a more efficient strategy.
   c) finger counting should be encouraged because success with using fingers better enables the young child to internalize number concepts.
   d) both a and b.

6. Metamemorial training (teaching children about their own learning processes)
   a) is most appropriate in kindergarten because this is when children are most receptive to this type of training.
   b) is successful at all developmental levels.
   c) is more effective at older ages because children are more cognitively mature and can better understand and utilize this information.
   d) has no effect on children's memory task performance.

7. A memory or study strategy that works with <u>first graders</u> will work just as well with <u>fourth graders</u>. T F

8. A memory strategy is best described as
   a) a voluntary, goal-directed activity to aid learning.
   b) a way of calculating mathematical formulae.
   c) a repetitive activity designed to stamp in facts.
   d) a fairly automatic technique children will adopt to deal with a task.

9. When children have to learn material for the first time, such as new vocabulary words, it is best if the teacher tells them
   a) to say the word 5 times.
   b) to write the words once with their favorite pencil.
   c) to study hard.
   d) to think of something the new word reminds them of and form an association.

10. Children who do not use efficient study strategies
   a) perform well in school.
   b) can be trained to use efficient study strategies.
   c) often are not identified until the fifth or sixth grades.
   d) do all of the above.

11. A kindergarten child is asked to study a group of 25 pictures for later recall. (The pictures show various items of clothing, animals, cooking utensils, and toys.) When studying, the child will probably
   a) just look at the pictures.
   b) rehearse by saying the names of the pictures over and over.
   c) organize the pictures into separate categories (put all the animals together, all the clothing together, etc.).
   d) give himself/herself a trial test before completing study to see how much has been learned.

12. Training studies have shown that the most effective way to increase children's understanding and use of strategies is to
   a) give strategy-affect training, instructing the children in how much fun a strategy is.
   b) show children an older child modeling strategy techniques.
   c) allow the children to do whatever they want to learn.
   d) give strategy-utility training so children can evaluate for themselves how effective a strategy is.

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Table 21

Questionnaire Used to Determine Teachers' Evaluations of the Workshop

EMORY DEVELOPMENT WORKSHOP

Content of the Workshop

Evaluate each of the following aspects of the information presented in he workshop using the 5-point scales provided, and please also write omments to explain your ratings.

How interested were you in the material presented?

Very Interested				Not at all Interested
1	2	3	4	5

omments:

How much of the workshop information was new to you?

All of it				None of it
1	2	3	4	5

omments:

What is the potential value of the workshop information for teachers?

Very Useful				Not at all Useful
1	2	3	4	5

omments:

How easily do you think you can apply these suggestions to your own lassroom situation?

Very Easily				Not at all Easily
1	2	3	4	5

omments:

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2. In your view, what was the most important point made in the workshop?

3. How easily do you think your children will adopt strategies like those discussed in the workshop?

Very Easily				Not at all Easily
1	2	3	4	5

Comments:

4. Give examples of how you have used the suggestions made in the workshop in your teaching this past week. Please describe how well they worked.

If you haven't used any of the suggestions, do you plan to do so? If so, tell about the situations or areas in which strategies can be suggested.

If you haven't used them and don't plan to do so, please explain why.

5. We know that the suggestions made in the workshop often remind teachers of procedures that they have developed themselves to help master particular tasks. Please give us some examples of strategy suggestions that you have used with children that we did not mention. (Please use opposite side of this sheet, if necessary.)

Table 21, continued

. Structure of the Workshop

aluate each of the following aspects of the workshop using the five-point le provided, and please also write comments to explain your rating.

l esentation	Excellent 1	2	3	4	Poor 5
ments:					
dio-Visuals/ monstrations	Excellent 1	2	3	4	Poor 5
ments:					
mples used to illustrate points	Excellent 1	2	3	4	Poor 5
ments					
tlines provided during workshop	Excellent 1	2	3	4	Poor 5
ments:					
douts given at end of workshop	Excellent 1	2	3	4	Poor 5
ments:					

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The following areas were covered in the workshop. Which of these do you think should have received greater or lesser emphasis?

	Needs greater emphasis	Emphasis OK	Emphasize Less
Memory development, as described through research	_____	_____	_____
Age changes in metamemory (knowledge)	_____	_____	_____
Strategies teachers used in our study	_____	_____	_____
How to train strategy use	_____	_____	_____
How to make training effective and lasting	_____	_____	_____

We are planning to present this workshop to other teachers in the future. If there are things we should CHANGE in the workshop, what are they? Please give as much information about your views as possible, so that we can improve our presentation.

THANKS AGAIN FOR YOUR PARTICIPATION IN THIS PROJECT!

was discussed briefly, after which some general principles of memory facilitation in the classroom were described. During the last 30 minutes of the workshop, members of the research team discussed with teachers specific examples of strategy and study suggestions for different grade levels, derived from our observations and interviews. Teachers were encouraged to describe techniques they had developed for use in their own classrooms and to talk about ways that they could apply some of the general principles of memory facilitation.

An initial presentation of part of the workshop was made to a group of students from the Department of Education at Tulane University. On the basis of their suggestions, we revised and elaborated the presentation. Subsequently, the workshop was given at two schools, where teachers were asked to complete questionnaires that would allow us to evaluate the workshop. Participants were given an initial pretest (Figure 20) to assess their knowledge of memory phenomena. They were given an outline to use during the workshop, and were encouraged to raise questions as information was presented. A short break for refreshments and relaxation was given after approximately one hour. At the end of the workshop, teachers completed a posttest, identical to the pretest and were given a copy of the workshop narrative. About a week later, teachers were visited in their classrooms and asked to complete an evaluation form that requested their judgements of the workshop. In a later presentation of the workshop to a small group at Tulane University, only an abbreviated form of the evaluation questionnaire was given.

Results and Discussion

Information Acquisition

Fifty-two teachers at the schools completed the pretest and posttest assessments of memory knowledge. Evaluations of the effectivenes of the workshop in promoting learning was assessed by comparing the accuracy of responses made by teachers before the workshop began with their accuracy at its conclusion. Analyses showed significant improvement in accuracy of responses from the pretest to the posttest, $F(1, 50) = 43.24$, $p = .000$, indicating that teachers did learn many of the basic concepts we were hoping to convey to them.

Workshop Evaluation: Content

Teachers responses to the evaluation questionnaire were coded on a 5 point scale, with a lower score indicating a more positive response. Participants saw the workshop as containing material that was interesting ($M = 1.62$ for 63 individuals responding), as having potential value for teachers ($M = 1.73$), and as being easy to apply in their

classrooms (M = 1.81, for 61 participants). Teachers were less likely to see the workshop information as new (M = 3.33, for 63 participants). They were reasonably positive about how easily their children could adopt strategies similar to those discussed in the workshop (M = 2.23, for 62 participants).

Workshop Evaluation: Structure

Teachers were generally positive about most aspects of the workshop presentation. They were very favorable about the workshop narrative received at the end of the session (M = 1.47) and the outline used during the workshop (M = 1.52). They also liked the audio-visual presentation (M = 1.63), examples used (M = 1.73), and the oral presentations (M = 1.81).

Teachers' Comments

When asked about the most important point made in the workshop, 63 respondents often mentioned memory strategies (33.3% of responses), either in terms of specific strategies mentioned in the workshop or with regard to the general principle of using strategies as a way of facilitating memory. Teachers also mentioned the importance of training children in effective memory skills (31.4% of all responses) and developmental aspects of memory (21.6%). Metacognitive notions were less often described (13.7%). In general, these comments concerning the main emphasis of the workshop represent the content of the presentation quite well.

Fifty-two teachers responded to a question about how they had used the suggestions made in the workshop in their own teaching. Teachers often mentioned some kind of self-testing (28.6% of respones) as an activity they had used successfully. Also mentioned were strategies that could be classed as elaboration (16.3%), organization (16.3%), or deduction (10.2%). Lesser mention was made of rote drills (6.1%), the use of concrete aids (4.1%), exclusion strategies (4.1%), or metacognitive activities (4.1%).

Finally, teachers were asked to make recommendations about the amount of emphasis that should be given to various workshop topics. Teachers generally felt that greater emphasis should be given to training (53%) and ways to make training more effective (57%). The majority felt that adequate emphasis was given to topics of memory development (82% indicated that this topic had received sufficient emphasis), metamemory development (76%), and strategies to be used in recall (68%). Teachers' responses to a question about what we could do to improve the workshop most often indicated that we should describe more strategies (19%) and use more videos (19%) or demonstrations (19%) during the workshop to make clear the ways that children behave and the ways in which trainng activities can be carried out in the classroom.

In general, we were encouraged by teachers' positive reactions to the content and structure of the workshop. Although they didn't evaluate the information we presented as extremely new or unfamiliar, they did report that the specific suggestions were useful, and they acquired a significant amount of information about memory processes in children. Their responses also indicated that they seemed to come to a greater appreciation of the value of strategy suggestions, the possibilities for their own role in training memory procedures, and the importance of a developmental perspective in teaching cognitive skills.

Chapter 5. Memory Development in the Classroom: A Workshop for Elementary School Teachers

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DEVELOPMENTAL CHANGES IN CHILDREN'S MEMORY AND STRATEGY USE

I. Introduction
   - A. What is a strategy?
   - B. Metacognition
     1. Metamemory
     2. Self-regulation of memory efforts
   - C. Teachers' role in strategy use and metacognition

II. Development of Study Strategies
   - A. Looking
   - B. Naming
   - C. Rehearsal
   - D. Organization
   - E. Self-testing

III. Metamemory
   - A. Role of the learner
   - B. Task characteristics
   - C. Influence of strategies

IV. Self-regulation of Memory Efforts

STRATEGIES OBSERVED IN THE CLASSROOM

I. Description of Classroom Observations

II. Types of Strategies Observed
   - A. Rote learning
   - B. Transformation
   - C. Deduction
   - D. Exclusion
   - E. Specific Aids
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TRAINING CHILDREN TO USE EFFICIENT LEARNING STRATEGIES

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VI. Memory in the Kindergarten Classroom

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Developmental Changes in Children's Memory and Strategy Use

The workshop that these materials summarize was the final aspect of a project on which we have been working for the past year. It has been funded by the National Institute of Education, and has involved a considerable effort to learn about what teachers of elementary school children do in their classrooms to encourage effective study and memory strategy use, and what they expect in the way of memory skills and knowledge of the children they teach. Teachers of children in grades K through 6 participated in the research; children from several schools participated in a followup study of first, second, and third-graders, also carried out last spring. In the workshop, we have attempted to integrate information obtained from teachers with other concepts and observations derived from the research literature on memory development and strategy training. We describe some of the important points in research-based concepts of memory development and training, and then attempt to give some very specific suggestions, appropriate to grade levels, to help in teaching materials that require memory activity.

Table 1, below, contains a very brief questionnaire concerning approaches that one might use in learning academic material. These questions illustrate two different ways of processing information, ways that produce very different "memory products." The odd-numbered items are all ones that involve a kind of processing that is fairly automatic and involves simple repetition -- repeatedly looking at or saying stimulus items, engaging in simple efforts to memorize. Such processing may result in learning, but often yields less long-lasting and stable retention of information than the kind of processing represented in the even-numbered items. This second way of processing information involves attributing <u>meaning</u> to the material that is to be remembered, by relating the new material to information already well-learned by the individual. This kind of processing usually results in better learning, better retention, ease in re-learning after a period of time, and generally, then, a more positive learning outcome than is shown with the more automatic, rote kind of processing described in Items 1, 3, and 5.

These items are used to illustrate a very basic principle that is the foundation of our work, that individuals have choices about the ways in which they attempt to process information and acquire knowledge. This is true as early as kindergarten, but becomes increasingly so as the child grows older. With age, the alternatives available, the "equipment" the child brings to the task, increase greatly. Today we want to talk about ways in which teachers can influence children's choices about ways of learning, so as to promote easier and more lasting acquisition of information. As indicated in the

Instructions:

Please think of when you were a student in college classes, and answer each of the following questions as a description of your own approaches to learning academic materials. Please place a letter "A" in the blank preceding items that describe study activities that you used VERY OFTEN.

Please place a letter "B" next to those that you used SOME OF THE TIME.

Please leave blank all items that are NOT characteristic of your own study activity.

_____1. I memorize factual information by looking it over once or twice.

_____2. When I study something, I devise a system for recalling it later.

_____3. To learn formulas, names, and dates, I say them over and over to myself.

_____4. After studying a unit of material, I often summarize it in my own words to see if I have mastered it.

_____5. For exams, I memorize the material as given in the text or class notes.

_____6. I learn new words or ideas by associating them with words and ideas that I already know.

outline, we'll first describe developmental changes in children's memory and strategy use, then we will report some strategy suggestions that we observed teachers giving to children in classrooms, and then we will describe some of the principles for effective teaching or training of cognitive strategy use in children. Next, we'll discuss some aspects of motivation before considering specific suggestions for separate grade level groups.

A key term that we will use in this discussion is the word "strategy." What is a strategy? Last winter, when we began this research, we were confronted with the task of devising an observational scheme that would let us record teachers' use of strategy suggestions in the classroom. We started with a very broad definition, taken from the memory literature, which involved two defining criteria: First, a strategy is an activity that somehow "moves the child along" toward the goal of learning, retaining, and retrieving information; second, the strategy is a voluntary activity, one that the child can choose to produce or not produce in a given situation. **Thus, a strategy is an activity that is undertaken voluntarily and that helps the child attain the goal of learning and remembering something.** It is "something extra" beyond the procedures the child needs to carry out in order to perform the classroom task. Thus, instructions such as, "Turn to page 24," "Be sure your pencils are sharpened," "Number the lines from 1 to 20," etc., although relevant to the task at hand, are not suggesting the voluntary, goal-directed activities that we would call strategies. They are simply procedural statements that prepare the child for task performance. Below on pages 8 to 12, we describe some of the kinds of strategies that we saw teachers suggest to elementary school children in order to improve their learning.

In choosing to employ a strategy, the child uses other kinds of memory skills, usually described by the term <u>metacognition</u>. These skills are involved in selecting, carrying out, and evaluating the usefulness of a strategy. There are a number of different activities involved in metacognition, and researchers have just begun to sketch out their characteristics. These metacognitive activities involve 1) metamemory, which is defined as the knowledge the child has about his or her memory processes, as they function in various task settings, and 2) self-regulatory activities, in which the child applies metamemory knowledge to monitor and control efforts to remember.

We began our research with the assumption that children learn a great deal about both strategy use and metacognition in school, and that teachers play a large part in this. We know from previous research that children change a great deal in both their strategy use and their memory knowledge over age, and we expect that the "practice" of memory skills in school has something to do with these changes. In fact, our observations indicated that teachers can play an active role

in encouraging children's memory efforts. Before proceeding to a description of teachers' classroom activities, let us consider briefly the nature of developmental changes in memory skills that have been described in the research literature.

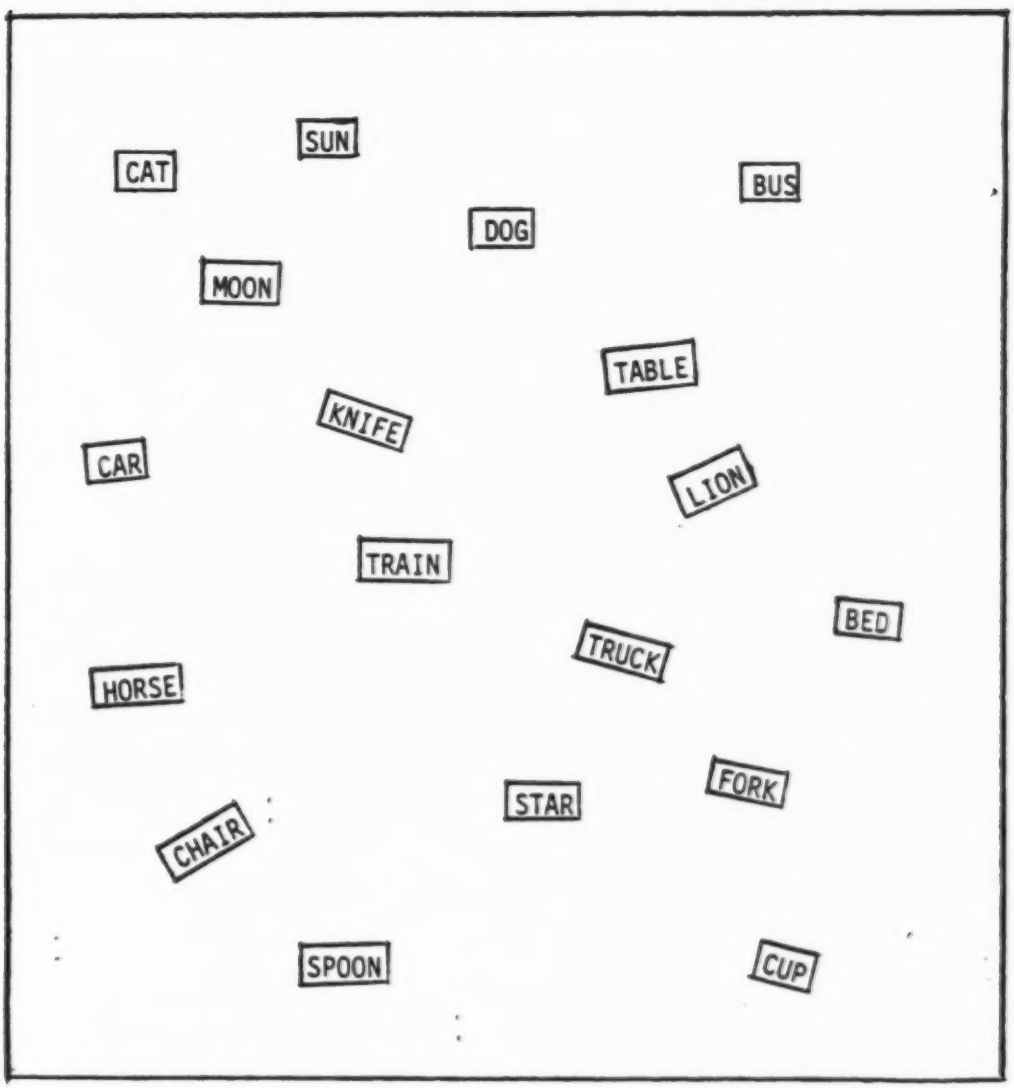
Development of Study Strategies

In general, research evidence indicates that as children grow older, they become increasingly organized and strategic in their approach to memory tasks -- better able to produce a strategy to fit the task and better able to make effective use of that strategy. Let's consider some typical developmental changes by looking at strategies in a task that has been used in a number of studies.

In the free recall task, the child is presented with a randomly arranged set of items, similar to those shown in Figure 1 below. Items usually are presented in the form of simple, easily labeled line drawings of familiar objects. The child is told to study the pictures until he or she is ready to recall them, and to indicate recall readiness, at which point the adult administering the task will cover the pictures and ask the child to say as many as he/she can recall. The child is further told that the pictures can be remembered in any order (thus, FREE recall), and that he or she can do anything during study that would be useful in learning the items. Performance in this task shows changes with age.

At earlier ages (up to approximately 6 years), children will engage in relatively simple strategies, such as looking at the items and saying the names of the items while looking at them. These strategies, although better than no study activity at all, are usually not very effective in helping the child learn the items. A more mature strategy, that will appear by 6 to 8 years of age, also involves verbalizing the names of stimulus items, but in a very different way. This strategy is rehearsal, in which the child says the names of as many items as possible WITHOUT simultaneously looking at them. Looking away, the child says the names of a series of items, perhaps randomly selecting from the array or perhaps rehearsing pictures in the order in which they are arranged on the table. Such rehearsal activity seems to be very useful when the memory task requires that items be recalled in a fixed order and that information be maintained only for a brief period of time. For example, you probably often use rehearsal in "keeping in mind" a telephone number while you attempt to dial it. Rehearsal has its limitations, though, as we suggested earlier, in that information probably won't be retained well over a very long period of time unless some additional strategies are used. For items like those here, it is quite easy for the child to find a more meaningful way of remembering the information, using a relatively mature strategy, that of organization. Finding a meaningful way to group the items, to relate them to each other, is a very useful strategy, one that will result in higher recall in

STIMULUS DISPLAY FOR A FREE RECALL TASK



nearly all instances. The list given here contains items from four conceptual categories (animals, clothing, vehicles, and people) that children should be able to understand. Another way of relating items on the basis of meaning might be to construct a story that includes the items in some systematic fashion. Grouping on the basis of meaning is a fairly difficult strategy for children, one that is not likely to occur spontaneously in this kind of task until the fourth or fifth grade levels. However, younger children can make use of organization if they are HELPED to think of and carry out a grouping strategy -- even children as young as kindergarten level can benefit by very direct training in the use of organization for remembering. Other research has shown that strategies that involve the elaboration of meaningful relationships between items are useful in a variety of tasks, including foreign language learning, relationships between written letters and spoken words (as in the beginning of reading), etc.

There is one other feature of the free recall task described above that is important to our discussion of strategies: the child has control over the length of the study period. How will the child decide when to STOP studying? What might a child do to see if he or she has learned the material well enough to carry out a correct recall? Several studies have demonstrated a developmental change in the way the child decides to terminate study. The young child (first grade or below) will tend to study for a short while and then quit. At second grade, a slightly more complex approach may occur, in which the child will use a systematic procedure such as saying the name of each picture two times or looking at all of the items three times. An older child -- usually by fourth grade on tasks like this one -- will systematically and regularly engage in a strategy called self-testing, in which he or she attempts a "trial recall" before completing study, in order to see how much information he or she has learned. When feedback from this self-testing indicates adequate learning, then, the child will indicate completion of study. Generally after such strategic behavior, the child's recall is very good, reflecting the acquistion that the child demonstrated during the trial test.

In the course of studying children's spontaneous tendencies to engage in strategies such as grouping and self-testing, researchers began to see that children changed with development not only in what they were likely to DO in memory tasks, but in what they seemed to KNOW about their own memories. The term metamemory has been used to refer to a child's knowledge of the operation of memory systems, including his or her own, under various tasks conditions.

Metamemory

What might a child come to know about the operation of

memory systems? First, the child comes to know about how aspects of the individual learner influence the ease of learning and the amount of learning that takes place. Children come to realize that younger children are less able learners than older children, for example; or they come to understand that memory ability is independent of other characteristics such as physical attractiveness or gender. By first grade, children realize that a child who has learned some material in the past but forgotten it will find it easier to learn than will a child who has not been exposed to the material previously. Later, they learn about their own memory systems, so that, for example by second grade, children can predict with some accuracy how well they will do on a memory task. By third or fourth grade, children will be aware of how their own study efforts and strategic behaviors can lead to good performance.

Second, the child learns about how task variables affect the difficulty of remembering something. For example, younger children will not be aware that delayed recall is more difficult than immediate recall and thus, requires more effort to retain information, while by third grade and beyond, children will know that immediate recall is likely to be easier and better. Similarly, by the third or fourth grade level, children will be more aware of the importance of recall requirements: That it is easier to recall a story in your own words rather than in the exact words given in the text, for example, or that the nature of their study activity should depend on the kind of examination that will be given to test retention.

Third, children learn about what strategies they can use to be more successful in particular memory tasks. They are increasingly able to generate potentially appropriate task strategies of the sort discussed above. Increases in knowledge of person, task, and strategy variables over the elementary school years all appear to increase the child's ability to deal with memory tasks in a variety of settings. The child learns to carry out strategies suggested by the teacher, becomes more able to create his or her own strategies, and learns how to judge the interplay of person and task factors in determining task difficulty.

Self-Regulation of Memory Efforts

As the child's knowledge of memory processes and his or her repertoire of potential strategies increase, there is an additional kind of development that is important for classroom learning. This has to do with the child's ability to monitor and regulate memory activities. The younger child, as indicated above, is relatively unplanful and nonstrategic in his or her approach to a memory task. With age, children acquire the ability to make a variety of judgments about how they are doing in a study-recall situation and become able to modify learning activities in order to become more effective

in studying. For example, by third or fourth grade, children can apportion their study time so that difficult items are studied longer than easy items. Fourth and fifth grade children are able to judge the relative effectiveness of two different ways of studying the same material and can regulate study accordingly. They can also judge correctly that they know something and don't need to study it further, or that they don't understand something and need to get some assistance. They can judge the correctness of an answer they've given, and eventually, can predict accurately how well they have done on a test. These are complex skills that we assume children exercise and refine through exposure to learning activities in the classroom.

Research has indicated that children can be influenced by appropriate training suggestions to show more mature skills at all three of the levels discussed above: strategy generation, knowledge of memory, and ability to regulate study efforts. It seems reasonable, then, that teachers are in a position to exert a considerable influence on children's memory skills through classroom activities. What kinds of things do teachers suggest?

STRATEGIES OBSERVED IN THE CLASSROOM

We have already talked about the definition of strategies and about how effective strategy use can improve memory. However, the studies described above have usually been conducted in the laboratory, and the training of strategy use has usually been performed on a one-to-one basis between experimenter and child. But as teachers well know, the classroom situation is very different: teachers have to communicate the same information to several children at the same time, and the environment can be distracting and much less controlled than the laboratory. Therefore, we'll consider next meaningful strategy instruction in the classroom, focusing on the kinds of strategies we observed teachers use while we conducted our study.

Description of Classroom Observations

In our study, we observed each teacher in five different lessons. Observers wrote a description of what they observed whenever a teacher suggested a "voluntary, goal-oriented activity" to help children learn and remember certain materials (see definition above of "strategy"). We have taken these observations and have tried to analyze and group them into meaningful categories so that we have a better idea about the kinds of strategies teachers suggest for specific activities. We found that most of the approximately 300 strategy suggestions made by 69 teachers in grades kindergarten through 6 could be described adequately by means of 12 categories.

Types of Strategies Observed

By now you have already heard about "rehearsal," and not surprisingly, many teachers suggested rehearsal-type activities to their students, which we have grouped into a category called ROTE LEARNING.

Some of the more interesting suggestions that we grouped into categories had to do with telling children how they could solve unfamiliar or very difficult-looking problems. Many of the learning and memory tasks in elementary school require children to apply knowledge they already have to a new problem. For example, in math, once the learner is familiar with the basic procedures such as addition, he or she can use this knowledge to figure out the answer to a more complicated problem by applying logical rules previously learned (i.e. 7-5=x can be solved by rewriting the problem as x+5=7). You can see that this method relies on transforming a difficult subtraction problem into an easy addition problem that children are more familiar with. Teachers would usually point out to children the underlying logical rules that allowed children to do such a TRANSFORMATION, and showed them how to rewrite or reformulate the problem. We observed teachers suggesting this kind of strategy as early as first grade. In second grade, teachers often told children that they could count by 5's etc., when they didn't know how to multiply, while fourth graders heard recommendations on how to reduce fractions. As you can see, the type of activity suggested will usually vary depending on the information to be taught. The transformation examples are usually limited to math because of the underlying logical rules involved.

An interesting category of strategies suggested for all kinds of subjects is one we have called DEDUCTION. Here, there are no logical rules underlying the items to be used, so children are instructed to use any clues from the given material, in addition to their general knowledge about the situation, to figure out ("deduce") the answer to a problem. For example, a kindergarten teacher suggested that a child look at the pictures that accompanied a story in order to figure out the answer to a question about the story. Starting in first grade, teachers tried to help children figure out unfamiliar vocabulary words by telling them to read the sentence or story containing the unfamiliar word and try to figure out from the context what the word could mean. Children were therefore encouraged to use knowledge that they already had about other words in the sentence -- in addition to any clues from the new word itself -- to figure out its meaning. Teachers instructing this strategy would also suggest that children try to sound out the word which requires knowledge about phonetics as well as use of the specific phonetic clues provided by the word itself. This type of strategy was most frequently suggested in 2nd and 3rd grade, but was mentioned by teachers at all grade levels.

Another interesting set of strategies had to do with what we call EXCLUSION. For example, in a first grade classroom, children had to find out which of several words belonged in the blank in a sentence. The teacher told the children that if they weren't sure which answer was correct, they should try out each choice systematically and see if that particular one made sense or sounded right. Children in this way learned to "exclude" incorrect options. If the children hadn't seen any of the choices before, it would have been a very difficult strategy; but if they were familiar with them, this strategy would help them to recognize and remember information that was already present in their knowledge systems but wasn't accessible until the children were presented with the choices. EXCLUSION can be suggested for a variety of tasks and subject areas. For example, math problems in elementary school often require children to fill in the missing operator or number (as in 3_5=8; _+9=12; etc.). Children who are familiar with the basic math facts and procedures but can't see the solution right away can use the exclusion strategy to systematically try out all signs or numbers to find the solution. We observed a math teacher in second grade suggest this strategy. In the upper grades, the EXCLUSION strategy was suggested as general test taking strategy for skills tests.

Many teachers suggested the use of some kind of EXTERNAL AID FOR ATTENTION. For example, a kindergarten teacher didn't want her students to get confused while they were counting, so she told them to touch each item as they counted it. Second grade teachers would have children use their fingers to follow along on the page when someone was reading, which helped the children pay attention to the task. Usually, such attentional aids were suggested in kindergarten through third grade.

With younger children (i.e., kindergarten through third grade), teachers would also recommend SPECIFIC AIDS for problem solving. For example, first grade teachers had children use colored blocks to represent addition problems, while third graders heard that they could use scratch paper to solve their problems. Research has shown that use of fingers, blocks, or other objects as ways of representing addition or subtraction problems is very helpful in children's becoming able to represent arithmetic facts to themselves later. Especially in kindergarten, first, and second grades, children seem to benefit by these concrete representations of arithmetic problems. Older children (third through sixth graders) were often instructed to use GENERAL AIDS, such as dictionaries, glossaries or other reference materials. When recommending the use of aids, teachers generally tailored them to the age of the child. In general, the younger the child, the more specific a teacher must be in giving the instructions on how to use an aid.

An interesting and useful category of strategies was what we called ELABORATION. Children in elementary school have to

learn many facts that don't have much meaning to them at first, such as vocabulary definitions and spelling rules. While it might be very tempting to have children memorize this kind of material by rote methods, we observed many teachers trying to make such learning easier for children by adding meaning to the material through the manipulation of elements already in the stimulus material. At the kindergarten level, for example, one teacher suggested an elaboration strategy for learning to recognize the names of color words: The teacher would write a word on the board and show children how they could draw around the word and outline its shape. Then she asked them what the shape reminded them of, and got them to remember that particular association (i.e., red=bed, yellow=faucet, etc.). Especially good about this strategy suggestion was that the teacher asked the children what they thought the word shape reminded them of, so that learning was made meaningful for each child. A fourth grade teacher used an elaboration strategy in explaining to children how they could avoid confusing the homonyms "m-e-e-t" and "m-e-a-t". She suggested that "meat" has the word "eat" in it, and one "eats meat". Thus, this teacher showed the children how they can create meaningful learning out of previously non-meaningful material.

You have already heard about self-testing, which many teachers suggested in an altered form. Most suggestions were made to go back over work and check it for errors before turning it in, suggestions we have grouped into a category called SELF-CHECKING. As you can imagine, checking for errors is a difficult task for children in the lower grades, and we found it was suggested mostly in grades 3 through 6. In order to help children learn, teachers should either model the activity or explain it carefully at first to show children how they can either check their work for errors or how to decide when they have mastered learning. Although we didn't find many suggestions for self-testing in the sense that children could have someone quiz them or quiz themselves, most teachers mentioned in personal interviews that they do recommend such procedures to parents.

Finally, an extremely important aspect of learning and memory is the learner's ability to know about the limits of his own memory and to know which methods are more helpful for memorizing. This capability has been named METAMEMORY by researchers. As children get older, as indicated above, they develop a fairly accurate assessment of their own memory processes. It is helpful to encourage children to think about memory activities at even young ages. We observed teachers telling second grade children to concentrate on studying the hard words for a spelling test. A high school student would already know this, but a second grader usually has to be told, because he or she has no idea of what to focus on. Some of the teachers we observed had very good intuition that young children might have problems in judging their own memory capacity, and were able to give them gentle "hints" to begin

this process. Very helpful suggestions by teachers at higher grade levels were to ask children to generate reasons why certain materials are easier to learn than others or to come up with their own strategies for remembering information. Even at the upper elementary grades, teachers can encourage students' self-awareness regarding the use of memory strategies and task difficulty, in order to help the child acquire skills that can be used appropriately when new kinds of learning tasks are encountered.

In general, teachers will have to be aware of the changes in children's strategic capabilities as they get older. While some procedures will not work with kindergarteners, others might. You all know your students best, and will find out easily which strategies work for you and your group.

TRAINING CHILDREN TO USE EFFICIENT LEARNING STRATEGIES

As already mentioned, results from many studies have shown that a major difference between immature and mature memorizers is the spontaneous use of efficient memory strategies. That is, when asked to "remember" or "study", the mature learner uses a variety of strategies that are not readily available to less mature learners. These less mature learners are not only young children, but also those children who have been classified as learning disabled, mentally retarded, or otherwise developmentally disabled in school. Researchers working with these immature learners have concluded that they suffer from a "production deficiency" -- activities or strategies that would aid recall are not produced spontaneously at times when they would be most helpful. However, they can use efficient strategies to their advantage when the strategies are demonstrated to them and they are required to use them. Not only can they use the strategies, but their recall or performance also improves as a result. It does not seem to matter whether the child knows why or even what is being done, performance still improves.

Training Studies

There have been many training studies reported in the literature that have been successful in improving immature learners' immediate memory task performance. These training studies have included young children, learning disabled students, and mentally retarded populations. However, many children have been reported to discontinue use of the trained strategies when explicit instructions referring to training are no longer present. For example, one group of researchers (Hagen, Hargrave, & Ross, 1973) instructed prekindergarten, kindergarten, and first and second graders to verbally rehearse on a seven-item serial recall task where they were required to remember the items in correct order. Children were instructed to rehearse the stimulus items on each trial by saying the name of the first picture aloud, then saying both the names of the first and second stimulus item when the

second picture was shown, etc. Thus, with each subsequent stimulus presentation the names of all the pictures which had been exposed were repeated in order. Children were prompted when they forgot an item or recalled one out of order during rehearsal. The researchers reported that rehearsal improved performance. However, they tested the same children one week later, but did not prompt or remind them of the rehearsal strategy. They found no maintenance of training effects one week later when no prompting was given.

Also, few children in the training literature have been reported to transfer or generalize the trained strategy to new and different memory tasks. A review of training studies indicates several ways in which the maintenance and generalization of trained study strategies can be improved:

1. by using very intensive training so that the strategy is well-learned,
2. by providing the child with feedback about the usefulness of the strategy for the task at hand,
3. by using verbal instructions or other procedures to make apparent to the child the potential generalizability of the trained strategy, and
4. by training children in "self-control" strategies in which they are given explicit instructions about overseeing, monitoring or regulating the trained strategy.

All four of these procedures can be used easily by teachers in the classroom when they are suggesting or presenting study strategies to their students. Some of the studies that showed the effectiveness of these procedures are described below.

Many investigators have reported that more than one training session produces better maintenance of training effects than one session. One group of investigators (Borkowski, Cavanaugh, & Reichhart, 1978) divided third- and fourth-grade students into those who received two training sessions (each session lasted three days) and those who received only one training session. Children received training in cumulative rehearsal, similar to that used in the study mentioned previously. The authors reported that more of the children who were trained in two three-day sessions maintained the strategy at a later date than was true for those children receiving only one three-day session. For teachers in the classroom, repeatedly reminding children to use an efficient strategy that the teacher has demonstrated may be one way of ensuring students' continued use of the strategy.

Providing specific information to a child about how a trained strategy improved performance has been found to promote maintenance of the trained strategy. For example, investigators (Kennedy & Miller, 1976) trained six- and seven-year-olds to rehearse on a serial recall task. Half of the children also received feedback about how rehearsing improved their performance (e.g., "See how much better you are doing

when you say the items over and over to yourself"); the other half was not given feedback about their improved performance. On post-test with no prompting to rehearse, 100 percent of the children who received feedback about their performance used the rehearsal strategy, while only 11 percent of the no-feedback group did so. Other researchers (Ledger & Ryan, 1982) trained kindergarten children to act out pictograph sentences: children were told ". . .This way of doing what the pictures say has certainly helped you remember them!" (p. 45). The authors reported that not only did trained children maintain the strategy two weeks after training but also generalized the strategy to an oral sentence memory task administered two days after training. These results suggest that classroom teachers should explain the benefits of any study strategy they suggest to their students.

Other investigators have attempted to increase maintenance and transfer of training by suggesting to children that a training procedure can be used at another time on other tasks. For example (Kestner & Borkowski, 1979), first graders were trained to generate elaborative strategies in a paired-associates task: Children were trained to make up questions about pairs of pictures to help them remember which two pictures went together. The trained children were also informed that this strategy might be helpful in other learning situations. The researchers reported that 87 percent of trained children maintained the strategy when they were not prompted to use it. They were also tested on a generalization task, where triads of pictures (instead of pairs of pictures) were presented, and it was found that 63 percent of the trained children used the trained strategy on the generalization task. Pointing out to students how some strategies are beneficial in other learning situations may facilitate students' use of those strategies in classroom study situations.

The most substantial transfer of training reported to date have occurred after training in "self-control" processes. These self-control strategies all involve the monitoring of problem-solving effectiveness or self-monitoring one's performance by self-testing. Self-testing behaviors appear to be critical aspects in many, if not most, study situations. If one is not aware that study behaviors have not been successful, it is doubtful that study will be continued or improved. In a recent study carried out at Tulane, third-grade children were trained to self-test in two training sessions (Leal, Crays, & Moely, in press). One-half of the children were trained in both free and serial recall, and the other half received training in either free recall or serial recall but not both. Each training session included the experimenter's explanation of how self-testing could be used and its value in learning. Each child was directed that if all of the items were not recalled during self-testing, this indicated that the child had not successfully learned all of the material and needed to continue studying. An example of

the instructions for the free recall task were:

> After you feel you have studied enough, close your eyes and try to say all of the pictures to yourself, counting on your fingers to see how many you can remember. Then open your eyes and check to see if you have remembered them all. If you don't remember them all, this tells you that you have not really learned them all yet and that you need to study some more. After you have studied some more, close your eyes again and check to see if you know them all. Ring the bell only when you can say them all two times to yourself without looking and have remembered them correctly both times. I think by studying in this manner you will remember more of the pictures.

At the end of each training trial, children were told the number of items they had recalled correctly and how much better they were performing than they had when they did not use the self-testing strategy. If during any training trial a child failed to self-test, she/he was reminded of the strategy and asked to try again. Therefore, not only was an efficient strategy demonstrated to the children, but the goals of training were explicitly stated, as were details of how the trained strategy would be useful in learning situations.

Maintenance and generalization of the training procedures were tested approximately one week after the last training session. Maintenance was tested using free and serial recall tasks similar to those used during training but with new stimulus items. Generalization was tested using new tasks in which it was suspected that self-testing would facilitate performance. Analysis revealed no significant differences between those children trained in only one task versus those trained in both free and serial recall. This finding was attributed to the fact that the verbal instructions provided to the children were explicit, and also that the children in the sample were achieving at or above grade level. Therefore, it may have been that these rather capable learners were able to profit from the verbal instructions alone and did not need to rely on practice with the trained strategy. Analyses of amount of time spent studying on all maintenance and generalization tasks revealed no differences between trained and untrained children. Differences were found during the one-week post-test in how the children spent their study time: Overall, trained children spent significantly more study time engaged in self-testing behaviors than untrained children did. Also, on three of the five post-test tasks, trained children showed performance superior to that of untrained children. Therefore, teaching children in the classroom to self-test their knowledge state may be helpful in ensuring successful task performance, especially if teachers also make sure that children are aware of why and how this strategy works.

In summary, younger children (prior to third grade) have been successfully trained to use and maintain rehearsal-types

of strategies, while children in third grade and beyond have been trained to successfully use rehearsal as well as "self-control" types of study activities. These developmental considerations should be kept in mind in classroom training attempts. For example, it may be unrealistic to expect a first grader to effectively engage in self-testing activities even after training. Also, teachers should remember that simply requiring children to engage in certain strategies may not ensure that the children will use the strategies on their own. Procedures used in successful training studies have real-life relevance in the classroom: teachers should explain the strategy many times or until it is well learned, tell students why the strategy is important and how it may be used in other study situations, and suggest self-control strategies, such as self-testing, that are useful in most study situations.

TRAINING METACOGNITIVE SKILLS

As indicated above, development of metacognitive skills during the elementary school years parallels the development of strategy use, and is thought by many to be necessary for the child's effective self-regulation of learning efforts. Several recent investigations have been concerned with training children's metacognitive skills and examining the influence of such training on memory task performance. Individuals can acquire knowledge about strategy use and effectiveness in several ways. Adults often will determine the relative effectiveness of different strategies simply as a result of "trying them out." However, children usually will not acquire such understanding on the basis of their own unguided efforts. Even 5th and 6th graders usually need some more direct instruction in order to evaluate the usefulness of different study or recall strategies. They also need guidance in applying knowledge about strategy usefulness that they may have acquired on their own: that is, children sometimes will be aware of the best way to study, but, for some reason, will fail to engage in that kind of study activity if left to work in their own ways.

How might instruction help promote the child's knowledge of memory strategies and his or her use of that knowledge? As mentioned above, giving feedback to the child about the usefulness of a strategy promotes learning, presumably by giving the child new knowledge about a strategy. However, much stronger effects on learning can be produced when more extensive information accompanies strategy training. In one study, for example, fifth and sixth graders who were given comprehensive information about an effective strategy were more likely to use the strategy on a new task than children who did not receive such information (O'Sullivan & Pressley, 1984). The effective instructions not only taught students the strategy and told them its use would aid performance, but also, told them that the strategy could be used in various learning situations, and indicated very specifically the kinds

of tasks for which the strategy would be appropriate and inappropriate. When children acquired this information about the strategy, they had the necessary knowledge to decide when and how to use the strategy effectively. Teaching that attempts to give children such an understanding of the effects of their own learning efforts is likely to be helpful in improving performance on a variety of tasks beyond the specific one for which the training is given.

At an even more general level, researchers have also become interested in developing training procedures that will help children to produce for themselves metamemory information about various strategies. Children usually don't attempt to produce such information, but can benefit from training procedures that encourage them to make evaluations of their own study activities. An example from a recent study (Ghatala, Levin, Pressley, & Lodico, 1983) shows how such training can be done with children as young as second grade. These children were taught "strategy-utility" understanding, by means of the following procedure: The children were told that there are many ways to play games, that some ways are better than others, and that in order to play the game well, they must use the best method. The children were given several examples: First, they were required to draw a circle using two different methods (free hand and tracing a circular cookie cutter). They were asked to determine which drawing was better, and why it was better. The children were praised for correctly answering the questions and were reminded that, "Keeping track of how you are doing when you play a game helps you choose the best way to play." The second example required the children to memorize a list of letters initially presented in scrambled order. The children studied the letters and then attempted recall. They were then instructed to arrange the letters so as to spell their own names, and after the letters were removed, the children again tried to remember them. The children were then asked when they had remembered more letters, why, and what they would do if they were to play the game again.

At the end of training, the children were given a memory task that involved learning pairs of words. After an initial effort to learn the words, the children were taught either an effective or an ineffective strategy for learning such lists. After practicing the strategy, children were given a new list to study and recall in any way they chose, and subsequently, were asked to explain what they had done and why.

Children who had received strategy-utility training clearly articulated the link between use of the strategy and changes in performance. They cited the usefulness of the strategy as the reason why they had made their choice. In contrast, children in control conditions had trouble explaining their performance and gave unclear reasons for their strategy choices.

Children who had received training were also able to abandon the ineffective strategy, basing that decision on their poor performance while using it. This is interesting, in that other strategy training studies have found that situational demand characteristics, such as the desire to please an adult, can influence children to use ineffective learning procedures.

Follow-up testing at a later time showed that these children also maintained their skills in choosing effective strategies. Children in the strategy-utility condition were able to use their knowledge of strategy efficacy to guide their choice of alternate strategies. The strategy utility training procedures provide practice in 1) monitoring one's performance, 2) inferring casual connections between strategies and changes in performance (strategy efficacy knowledge), and 3) selecting an appropriate strategy based on such knowledge. When children are taught general principles for deciding on an appropriate strategy for a task and for assessing their performance using the strategy, strategy maintenance and generalization to new tasks is improved.

The schoolroom environment offers a rich setting to facilitate the development of children's control and "executive" processes in the activation of a wide variety of strategies. We want to encourage teachers to apply these principles in the classroom, in order to maximize the development of memory knowledge, self-regulation, and use of strategy techniques.

MOTIVATION

In encouraging children's memory efforts, we know that teachers have to be concerned as well with getting children interested in performing classroom tasks. We asked teachers in our study to tell us some of the things they did to motivate children to learn. We would like to present some general principles of motivation, not to give all the answers to this difficult question, but to reflect the findings of research and the comments of the teachers in our study.

A. Sources of Reward in the Classroom

A classroom teacher is a very important and powerful figure to the child, especially in the early grades. Even at the sixth grade, teachers were aware of how important their attention and approval were for children's continued efforts in their work. A sixth grade teacher we interviewed told us that she would sometimes "sell time" to children: if a child had done well or tried hard, the child could "earn" individual attention from her. However, not all children are the same, and some may regard individual attention from the teacher as a negative experience. For such students, classmates may be more important as a source of reward, as models for their own behavior, and as the

carriers of values. This becomes increasingly true at higher grade levels. Thus, we often saw fifth and sixth grade teachers dividing their classes into groups that would work on projects together. If the group has a well-defined goal, and a structure within which to work, the group can help to maintain children's task motivation. For example, a sixth grade teacher established a group structure in arranging students at tables and appointing a "group leader" for each project, projects that involved writing and acting out short plays or preparing reports on various topics.

Some teachers reported the use of external rewards: gold stars on charts for work completed, tokens to collect and turn in for other prizes, etc. -- for some teachers, these worked very well, but others found them to be ineffective. There are some points to consider in using external rewards:

a) the reward should be something that the child will really enjoy. If the child hates M&M's, they'd be a useless reward.

b) the teacher needs to be sure that the children understand the relationship between what they do and what the reward will be, and then the teacher has to be very reliable in providing reward when the appropriate behavior has occurred. If children are to get a star for turning in their homework (regardless of quality), then the star should be given even for a poor paper. If the specification is that the work has to be correct and on time, then both of those must be considered in giving the reward.

c) for the same reasons, rewards need to be immediate for the young child -- having parent reward or punish or reward at end of week probably won't be effective in motivating behavior days earlier.

d) the reward system may need to be changed regularly, to keep children from becoming bored or satiated with it.

e) the teacher needs to consider whether an external reward system is really necessary, given other sources of reward in the classroom (teachers, peers) and also depending upon the nature of the task itself.

B. Influence of the Task on Children's Motivation

Research has shown that external rewards have very different effects depending upon the extent to which the learning task has intrinsic interest to the child. Let's consider three kinds of task: First, a task that is very interesting to the children. Sometimes materials are well-designed to elicit interest: readers with good illustrations, exciting stories about topics children enjoy, etc. The teacher should try to use the children's interest as the basis for motivation -- let children pursue their desires to investigate and learn. If the task is very interesting, the teacher won't need to give external rewards -- praise for progress is fine, of course, but giving tokens or prizes for the child's doing what he or she likes to do anyway may signal to the child that perhaps the task isn't so much fun, if the

teacher thinks it's more like work! So external rewards can "backfire" and have the opposite effect, causing the child to lose interest in the activity.

Second, consider a task that isn't in itself all that exciting to a child, but that has the potential to arouse interest. This is probably the most challenging situation for the teacher and brings out one's creativity: How can I make fractions interesting to Johnny? A very basic point here is that children, especially at earlier grades, look to the teacher as the model of what is interesting: If you can yourself appreciate the beauties of the logic in mathematics, or if you find a story interesting, you can convey that to the child. A teacher we observed spent time at the introduction of a new story in the reader modeling for the children some questions that they might ask themselves about what they were going to read. The teacher didn't say, "Children, these are the kinds of questions you might ask," but instead, opened the book, read the title aloud, commented on the first picture, looked through the story for each of the pictures, speculated and invited the kids to think about what the story could be about: Why was that steamship in the picture? What was this boy doing on top of the lighthouse? The teacher encouraged the students to offer suggestions, ask further questions and give their speculations, and got them excited about what was in the story. Another example: Last spring, Michael Jackson was a real craze in the schools, and we saw teachers making use of that interest: One teacher brought magazines and let 6th graders read about the rock star's personal history as a basis for their own written reports on his life.

Finally, there are tasks that are not so interesting to students and that are difficult to make interesting, but that need to be done: learning spelling words or times tables, for example. With these things, teachers are often successful at using games or other activities that challenge the child to master the material. External rewards may be used, or children may be encouraged to compete against their own records (timed tests for practicing math facts, for example), or the teacher may devise games that involve mild competition between children. Games are useful in giving the child practice with the material, and should be set up so that they give the child feedback about performance, so that the child can become more aware of what he or she knows, what needs study, and how much performance is affected by study efforts.

C. Make it Possible for Children to Succeed

Research has shown that if individuals fail consistently, they eventually give up and withdraw from the situation in which the failure has occurred. It is very discouraging for a child to get into a situation in which he or she is the low child in the group and experiences a lot of failure. It is important to make it possible for each child to succeed in

class. How can this be done?

a. The teacher can praise and reward children for trying their best and for improving over their previous performance, rather than reserving reward for perfect papers only.

b. To the extent that instruction can be individualized, the child should be given tasks on which there is a reasonable expectation that he or she can do well. If the child can't multiply, it's not time to proceed to division, obviously.

c. Competition with the self is to be encouraged, rather than competition with others. Did Johnny do better this week on his spelling test than he did last week? How many items can you complete correctly for homework relative to how you did yesterday?

d. When competition between children is used, it should be possible for each child to win. The teacher might group children of similar ability together to compete in a game, so that the contest will be relatively even. A teacher we saw used spelling lessons in which success each week was independent of that for previous weeks (rather than a cumulative record), so each child had an equal chance of being recognized for performance at a given time.

e. There are a variety of classroom tasks at which children can excell: reading, math, spelling, but also art work, helping out in class, remembering classroom events or schedules. Each child should be a possible "winner" or "expert" at something.

D. Encourage Intrinsic Motivation

The teacher's ultimate goal is not just to get work done, but to enable the child to become an independent and self-motivated learner. Ways in which to encourage the child's motivation toward mastery of school tasks include the following:

a. provide learning experiences at an optimal level of difficulty -- ones at which the child can succeed, but not so easy that the child is bored.

b. encourage competition with one's own record, rather than with others. (If someone wins, someone else has to lose.)

c. Notice and reward children's efforts to IMPROVE their performance in areas in which they are weak, even if they haven't yet become fully competent. Rewarding progress helps promote further effort.

d. Praise the child's good performance in terms of mastery, stressing that the child knows the material or is a good learner.

e. Encourage children to reward themselves for good work, so that they can become less reliant on the teacher or on friends to tell them when they have done well. Help them recognize good work and feel proud of themselves for doing better than they have in the past.

E. Teacher Expectations

Research has shown that what the teacher expects of the

child is very important in determining how well a child will do. Try to keep an open mind about who is likely to end the year as your outstanding class members or your most improved student. Give the children a chance to surprise you!

GENERAL PRINCIPLES OF MEMORY FACILITATION

In the sections below, we present information obtained from teachers through our interviews and observations. The grade levels are divided into kindergarten, first, second and third combined, and fourth through sixth combined, because we found that these divisions allow us to illustrate the kinds of memory activities and strategy suggestions that appear at different developmental levels. Sections are organized according to several general principles of memory strategy use and training that we developed on the basis of our review of the literature and by listening to teachers. These principles are the following:

A. Memorization should always take place in the context of meaning. The child must understand very broadly and clearly the information to be learned. In learning vocabulary words, for example, children need to understand the usage of the word, things it is related to, etc., so that they can produce their own definitions of the words, rather than just memorizing formal dictionary definitions. In math, an example would be the need for the child to understand the operations of addition and subtraction and the relationship between them, in order to give meaning to mathematical facts.

B. Rather than relying on repetitive, rote activities as a way of producing memory, the teacher should try to devise situations in which the child can use the to-be-learned information in an active way. Many teachers develop games that allow children to exercise their skills and receive feedback about answers, so that they can check their own answers and learn the correct ones. Examples are given below.

C. If rote activities are used, they should be structured by the teacher so that they will not become meaningless, tedious routines that children carry out in a mechanical fashion. Teachers of the earlier grades, especially, reported that it is necessary to change activities often, to require a limited number of repetitions of the same activity, and to vary the nature of activities so as to maintain children's task involvement and interest.

D. For things that are important to remember, repeated involvement with the information is necessary in order to promote long term retention. Teachers report various ways in which they encourage children to review or reconsider information that was presented earlier, so that, with repeated exposure and learning, children acquire a broader, more stable knowledge and understanding.

E. In order to promote context-free learning, teachers should vary the learning situation so that the child does not rely on incidental cues as a way of achieving correct answers. Even at the higher elementary grades, teachers notice that sometimes children happen to get caught up on irrelevant cues

in remembering: For example, a child learns the spelling word list in order and can't spell the words out of sequence, or the child learns to use a particular map and can't transfer knowledge to a new, different map. In order to promote context-free learning, tasks can be presented in a variety of ways and children's learning can be tested in a variety of contexts, as well.

F. Metacognitive skills show a developmental course that will influence the ways that teachers can encourage the child's self-awareness over age levels. At the earlier grades (kindergarten and first grade), the teacher can begin to help children be aware of their own memory processes by teaching them how to get help from another person to check their knowledge state (by calling out words to them, checking their math facts, etc.). First and second grade teachers may encourage their children to check their work, but must teach them what to do, specifying the routines by which checking is to be done (e.g., repeat the calculations in math, compare your work to a standard, etc.). At second and third grade levels, the teacher can begin to encourage children to think about their own memories and how they can remember something, and in introducing strategies, can show children that some ways of learning things work better than others. At second and third grade levels, teachers can be very effective in demonstrating or instructing strategy and metacognitive activities. It is important to make clear to the child not only what to do to learn better, but why a method should be used and its value for learning. By third grade, the child can be taught to "self-test" so as to determine the effectiveness of study in promoting his or her memory, and to use the feedback from self-testing to determine whether more study is required. At fourth through sixth grade levels, children have become quite competent at generating strategies on their own, but now can benefit from teachers' efforts to encourage development of their metacognitive skills. Teachers can help children understand what makes a problem easy or difficult, as the first step toward planning how to deal with it more effectively. Teachers can encourage children to formulate their own plans for learning, to evaluate the effectiveness of their approaches, and to modify learning activity on the basis of such feedback.

In the sections below, we use these six principles to summarize some of the suggestions that teachers gave us about how they work with children in the classroom. We also describe the kinds of strategy suggestions that teachers at these grade levels made in the classroom to assist their students' learning.

MEMORY IN THE KINDERGARTEN CLASSROOM

In classroom observations, we saw kindergarten teachers suggesting various strategies to help children attend to tasks more consistently. As well as cautioning children to work carefully through each step in a task, teachers would

often suggest that children use markers to keep their place in a book or use their fingers to keep track of their counting operations. Such attentional guidance is important in helping children take in task-related information so that it can be learned.

1. Kindergarten teachers often relied on the principle that memory activity should take place in the context of meaning. In order to encourage this, teachers adopted such activities as the following:

a. When children were first beginning to develop word recognition skills, one teacher used an elaborative strategy to help them identify simple words on the basis of their shapes. She showed the children a new word and asked them to decide what its shape looked like, and then used an elaborative strategy to relate the word to the object the children mentioned. Thus, "bed" was used as a cue to recall the word "red" and, as mentioned earlier, a "faucet" was related to the color word, "yellow."

b. In math activities, teachers usually tried to make numbers and simple number problems very concrete by employing counters or visual aids. Some teachers had the children string beads together or take them apart to illustrate adding and subtracting operations. Others suggested using pictures to illustrate simple word problems in arithmetic. As the children began to learn about arithmetic, one teacher encouraged them to make up their own stories to illustrate mathemetical processes: "Sally had two apples that her Mother had given her. She picked one apple from the tree, and then she had three apples in all."

c. In learning vocabulary words, a teacher suggested having the children create "pictionaries" in which they learn the word together with a picture of the object that the word names.

d. In an effort to help children comprehend the sequence of events in a story, teachers sometimes used flannel boards on which they could retell the story with the children's help. Other times, children were encouraged to dramatize the story as a class activity.

2. Kindergarten teachers often used game-like, active situations as the occasion for practice of concepts being learned, rather than relying on rote activities. Among the many suggestions we heard were the following:

a. One teacher modified a "Candyland" game, so that children saw color words on the cards used to direct a marker along the "road" rather than the usual color cards. Children also had a "key" available, in which color names were matched with the colors to which they referred, so that children could check and make sure that they were correct in labeling the color word. The opportunity for such feedback and self-correction is necessary in any game if it is to be an effective learning tool.

b. Games for identifying words involved a variety of activities: bingo, a hop-scotch game in which the child had to

jump to the word given, and a fishing game in which the child got to keep each "fish" card for which he or she could read a word correctly. One teacher created a game using a zig-zag road made of cards containing vocabulary words, in which children moved along the road as they read the words correctly.

c. Teachers reported using dramatizations, finger plays or little songs to help increase children's comprehension of stories.

3. Another principle involved activities aimed at producing long-term retention of material through regular, repeated involvement with it. Examples were as follows:

a. Teachers often incorporated basic information, such as telling the time of day or noticing the weather, into their daily routines, in order to make this learning a very natural part of the classroom activity.

b. Some teachers told us that they begin the morning with routines such as counting from 1 to 10, or saying the names of letters given on cards around the room, adding new items weekly but continuing to repeat the more familiar ones. Such activities promote lasting knowledge, and also can be positively motivating to the child, increasing his or her feelings of competence in knowing the familiar materials and the routines that will be followed.

4. In order to encourage learning that is context-free, teachers used several activities:

a. In letter recognition, a teacher would ask the children to find a letter they were learning in magazines, on signs located around the room, in the names of their classmates that were written on the board, in newspapers and magazines at home, or on signs as they drove around town. A similar process was followed for simple words the children learned, so that they were encouraged to find the word in stories or books, on signs, etc., as a way of learning to recognize it in many different contexts.

b. In learning addition, the teacher illustrated 1 + 1 = 2 by having children use their own bodies to illustrate the problem. The teacher also used varieties of counters, fingers, etc., so that the children would come to see that 1 + 1 = 2 can be applied to many different situations and activities.

5. To encourage the beginnings of metacognitive activity, several teachers mentioned asking parents to help the child by showing the child cards containing vocabulary words and seeing if the child could identify the words, or using flashcards to quiz simple math facts. At this age level, a parent or a teacher provides support for the child's first efforts to evaluate his or her knowledge, as well as assisting in the learning process.

MEMORY IN THE FIRST GRADE CLASSROOM

First grade teachers gave us a number of examples of techniques they found to be effective in encouraging memory activity in their classrooms. Their suggestions also exemplify some of the principles described earlier.

1. First grade teachers often tried to place memory activity in the context of meaning, attempting to ensure that the child would understand the information to be learned. Procedures suggested include the following:

a. In learning addition or subtraction operations, most teachers encouraged children to use counters such as blocks, beads, or their own fingers. Sometimes the teacher gave children a drawing or asked them to produce a drawing to represent an addition or subtraction problem. Other teachers used number ladders to show the addition and subtraction processes. Use of such external representations of the mathematical problem helps the child understand the logic of the operation being performed and also, with the teacher's assistance, gives the child a way to check and make sure that his or her answer is correct.

b. Teachers used transformation strategies to help children understand the operations of addition and subtraction, as well. For example, teachers showed children how they could use addition facts to find the correct answer to a subtraction problem: "You can use what you know, 8 + 1 = 9, to figure out 9 - 1 = _."

c. Vocabulary words for the week were usually chosen from a story or reader that the class was discussing at the same time. A teacher noted that it was best to present words that had a shared meaning based on content or on their relationships in a story. She noted, "If children do not learn words in context, they are meaningless." In order to remember the word and especially, to begin to use the word in reading or speech, the child needs to be able to understand the word's meaning and use, and the best way to ensure this is to have the word placed in a context that the child can comprehend.

d. Spelling words should be ones that children know and can actually use in their own writing. Spelling activities should emphasize the meaning and appropriate use of the word in a written context rather than just its spelling.

2. First grade teachers often found that rote activities were less effective than other ways of exposing children to material to be learned. Rote activities tended to become mechanical, so that children, for example, would begin to make mistakes in writing their spelling words after a few repetitions, or would no longer attend when they were told to write math facts over and over. Therefore, teachers instead chose to develop activities in which children would be more active, including the following:

a. Games such as Scrabble, Anagrams, or crossword puzzles were used to aid the child's learning of spelling

words, by giving diverse opportunites to practice the words and to receive feedback about accuracy in their use.

b. A Concentration game was adapted so that children could use it to practice addition and subtraction facts. In the game, flashcards are placed on a table so that you don't see the side with the answers. Children take turns choosing two flashcards, attempting to select two for which the answer to the addition or subtraction problem is the same. (For example, a correct response would be to pick "2 + 4" and "7 - 1.") If the child is correct, he or she gets to keep those 2 flashcards, and the child's progress is noted in terms of how many cards he or she collects.

c. Teachers often encouraged children to produce examples that illustrate concepts or facts being learned. For example, some teachers asked children to make up sentences or stories on their own using their vocabulary words. Similarly, children can make up their own word problems to illustrate particular mathmetical concepts, after some initial demonstrations by the teacher.

3. Teachers encourage the development of early metacognitive skills in several ways:

a. Many teachers at the first grade level begin to ask children to check their own work, so that the children can assess how well they have performed. At first, the teacher should be explicit in teaching exactly what the checking procedure involves. For example, the teacher may ask children to compare their spelling words or their answers to math problems to the examples on a standard list that is handed out or posted on the wall. It is important to make the instructions very clear and to keep the task fairly simple, with only a few items to check, and to watch and see that children understand what to do. Teachers sometimes devise games in which children can check their own answers by looking at the back of the page or by using a cover sheet that shows correct answers. Such activities are useful in helping the child learn that it is possible to evalate one's own performance, as well as in allowing independent work and prompt feedback about performance.

b. As in kindergarten, teachers often encourage children to find another person to aid them in learning spelling or vocabulary words or math facts, by having the other person "call out" the problems to them. This allows the child to carry out a practice test to see how well he or she is doing in learning some material. It is important that the parent or other individual not only help the child carry out the trial test, but make sure that the child realizes that the items missed are the ones that will require additional study.

c. Children at the first grade level usually are not very aware of their own memory abilities, and the teacher probably can only encourage the beginnings of such awareness. Within the context of a lesson, for example, the teacher might ask children to think about how they tried to learn the material. When appropriate, the teacher might suggest alternative strategies and explain to the children that some

ways of study are more effective than others.

MEMORY IN SECOND AND THIRD GRADES

This section describes activities that second and third grade teachers can use when presenting material in order to help their students learn and retain information. General principles illustrated here are presented first, followed by concrete suggestions for activities in the areas of vocabulary, spelling and mathematics.

Among the principles that we found to be important at this grade level are the following: Memorization or study should always take place in the context of meaning. If material is not meaningful for students, they will have a difficult time learning. Repetitive, rote activities should be structured so that they are not likely to become meaningless, tedious routines. This means that teachers are often required to devise situations in which children can use the to-be-learned material in an active way. Many teachers suggested that children seem to learn and remember best when material is presented as a game or is made relevant to the students own lives. By second or third grade, children are developing metacognitive skills. This means that they are beginning to understand their role in the learning or memory process. They also are beginning to understand that some study or learning strategies are more effective than others. Second and third grade teachers were more likely to suggest strategies to their children than were teachers at any other grade level. So it appears that second and third grade teachers play a particularly active role in affecting both the ways that children study and what children are learning about memory strategies and metacognition. Some examples of activities suggested by teachers that require children to process material in an active manner are the following:

1. Vocabulary Learning

a. One teacher said that she divided her class into two teams (of equal ability level) and had each team take a turn pulling a vocabulary word out of a hat. The child who pulled the word out of the hat was to tell the word's meaning. The team that got the most points (the most correct definitions) won the game. Her children found this to be a challenging and interesting activity. By adding words from previous lessons, the teacher could promote long term retention of vocabulary, as well as practice with new words.

b. Another suggestion was to have student volunteers "act out" vocabulary words in front of the entire class. Sometimes students were asked to look for pictures in magazines or to draw their own pictures in order to demonstrate the meaning of a vocabulary word.

c. Many teachers provided children with mnemonic devices to help them remember the meanings of certain words. For example: To distinguish the words "here" and "hear", remember that the word "hear" has the word "ear" in it and we

"hear" with our "ears." The difference between "fact" and "fiction" is that "fact" has a "t" at the end of it, so it must be true.

2. Spelling

a. Several teachers mentioned that they point out to children that some of the words in a spelling lesson are hard or "tricky" words. They suggest to children that they should spend more time concentrating on these "watch-out" words. In doing so, they are encouraging metacognitive learning as well as improved spelling.

b. Many teachers suggested providing children with mnemonic devices for remembering spelling words. For example: There may be familiar small words inside of the larger words children are learning. Or, teachers may mention to students that all of the spelling words in one set end in "ly" except for two. Teachers may mention that words that sound the same are often spelled similarly.

c. One teacher suggested a tic-tac-toe game for practicing spelling words. The class is divided into two teams: an X team and an O team. A child is given a word to spell (as in a spelling bee), and if a child spells it correctly, he or she gets to place an X or O in the tic-tac-toe form. If the child does not spell the word correctly, the other team gets another turn. The group structure of this game allows peer encouragement to motivate children and avoids the "one winner/many losers" characteristic of the traditional spelling bee.

d. Another teacher said that she had her children keep a dictionary of words that they had misspelled (either in their creative writing or on spelling tests). Children put 26 pieces of paper into a folder, one page for each letter of the alphabet, and used this notebook all year to keep a record of the words that they had misspelled. Subsequently children were never to ask the teacher how to spell these words, but instead were expected to look them up in their dictionaries.

3. Arithmetic

a. One teacher suggested the "hula-hoop method" for demonstrating multiplication. She put hula-hoops on the floor and asked equal numbers of children to stand in each hula-hoop in order to demonstrate sets. For example, to demonstrate the problem "3 X 4", she would put three hula-hoops on the floor and have four children stand in each of them. As children came to understand the procedure, the teacher would let them figure out how to illustrate new multiplication problems.

b. Another teacher played an "around the world" game with her math class: One child stands next to another child. The teacher shows these two children a flashcard with a math problem on it. The child who gives the correct answer first is the winner and gets to move on and stand with the next child. The teacher shows another flashcard and the child who responds correctly first is the winner and gets to move on to the desk of the next child in the room. Therefore, a child who knows his or her math facts and can respond quickly may be

able to move all the way "around the world" (around the classroom). The teacher found this to be helpful in motivating children to learn their math facts, as well as a way of giving them practice.

c. The Concentration game (described earlier in the First Grade section) is also used at this level, but expanded to include multiplication and division facts as well as addition and subtraction.

d. Several teachers stated that they let the children in the classroom "play teacher." That is, children take turns going to the board to work problems. While they are working the problems, they explain to the class the procedures or steps they are going through in order to solve the problem. The teacher suggested sending the better math students up to the board first, to give the other students a chance to catch on to the correct procedures.

e. Many teachers suggested having children "act out" various math problems. For example they can play grocery store which requires them to add up the total cost of the grocercies, provide an adequate amount of money and subtract to make change.

4. Self-checking and metacognitive suggestions

Teachers suggested a large number of self-checking activities to children in the classrooms at these grade levels. Sometimes they also offered good suggestions about how to carry out the self-checking activity: Children were told that in order to check a workbook activity, they should reread the story upon which it was based and look for the answers. Before turning in an essay, students were told to proofread their papers to make sure they had written down everything they had wanted to say. Another teacher told her students to reread sentences they had written to see if they had used verb tenses correctly and to see if the sentences made sense. In doing math problems, a teacher suggested to children that they write down every step in the problem so that they would be able to go back and find any errors in their computations. Such suggestions make it clear to the child exactly how the self-checking operation is to be done and what information needs their attention.

In encouraging metacognitive activities, teachers often pointed out to children that they should study more difficult spelling words longer than they studied easy ones. Teachers also sometimes asked their children to describe plans that had been mentioned in class for remembering material or ask children to generate such plans. Usually the teacher had to follow up these requests with specific suggestions to help children formulate a plan, rather than expecting them to be able to produce one without assistance. In suggesting strategies, teachers often indicated specifically to students that the strategy would help them remember and why. At the second and third grade levels, such information is effective in helping children maintain strategy use, as well as increasing their awareness of memory processes.

MEMORY IN FOURTH THROUGH SIXTH GRADES

At the fourth grade level and beyond, children are already capable of using many of the memory strategies that we have described, but the teacher can play a particularly important role at the level of metacognitive learning. Teachers at fourth through sixth grade levels demonstrated an awareness of general principles of using active, meaningful ways of learning and teaching for context-free and stable learning.

1. In the area of metacognition, teachers tried to help the child become increasingly aware of his or her own memory processes. Procedures to encourage such awareness include the following:

a. Self-checking. Children can be encouraged to check their work, to see how well they have done at a task, and also, to use self-testing as a way to see if they know something or if they need to engage in further study in order to master the material. Practice tests in spelling, for example, show children which items they know and which they need to study. Along with this, a teacher might ask children to predict ahead of time how well they will do on a test, in order to increase both their motivation and their self-awareness.

Children can be encouraged to ask themselves if their answers "make sense." For example, a teacher reminded children that in checking their subtraction problems, the answer has to be less than the number you begin with. Another teacher told students to check their answers by estimating the answer to the nearest 10's value and then seeing if their answers were close to that estimate.

b. Identify potentially difficult tasks. Teachers can help children become aware of what sorts of task are going to be easy or difficult for them. One sixth grade teacher told children to think about it: "Which ones do you think you will be able to learn easily? Why? Which ones are going to give you trouble? Why do you think that is?" The teacher tried to get students to think about why certain tasks are so difficult and how they might deal with them more effectively.

In math, one teacher mentioned that she asked her class to review problems on which students made errors to see if they knew why the answers were wrong, and for children who answered the items correctly, to see if they could explain how they got their answers. She found that sometimes students would get the right answers but not understand why. By getting them to explain their work, the teacher helped students understand the operations they had done correctly, and at the same time, provided information for the children who were not able to do the problems.

c. Feedback for memory efforts. The teacher can give the child the opportunity to try out different ways of studying and see how well they work. One teacher wanted her students to learn to identify geographic areas on maps of the world. She gave them several sample maps that they could use

to test themselves during study. This gave students the chance to provide themselves with information about how well their learning was proceeding.

A fifth grade teacher asked students to decide for themselves if they could construct an adequate definition of each vocabulary word or if they needed to use a dictionary to find a correct definition. The teacher gave feedback as to the adequacy of the definitions the children produced, so that they could learn how to evaluate the quality of their own definitions.

2. Another way that the teacher can influence metacognitive activity in children is by encouraging them to develop their own ways of studying and to evaluate how well these work. Suggestions by teachers include the following:

a. A sixth grade teacher wanted children to learn countries, continents, and cities on a world map. She showed the class several techniques for studying, including grouping sections by color, grouping by location on the map, and arranging items in alphabetical order, and showed the children how to try out these different techniques in order to see which ones worked best for them.

b. Teachers at fourth through sixth grade levels mentioned that they encourage children to develop their own ways of relating items or making them meaningful, in both vocabulary and spelling lessons. Children found ways to relate spelling words to words already known that sound the same, and produced elaboration techniques to make vocabulary words more meaningful. Teachers also can encourage students to discuss ways of studying and memory strategies that work well for them. Children may have developed effective strategies of their own that would be useful for others.

3. Another principle that teachers at the fourth through sixth grade levels used in working with their classes was that of encouraging active learning rather than emphasizing rote, repetitive drill as a way of getting experience with the material to be learned.

a. In learning vocabulary words, many teachers emphasized the importance of making the word familiar to the child so that the child learns to use it in conversation and writing. Techniques for achieving this included writing sentences, or even stories, plays, or reports with vocabulary words, having the children act out the vocabulary words in front of the class, or playing games with the words. Some teachers asked children to make up "silly sentences" using a long list of vocabulary words in one sentence that goes on and on. Another procedure involved the teacher using the vocabulary word in a sentence and asking the child to produce a synonym for that word. One of the games teachers mentioned was "Vocabulary Bingo" in which children make up cards with words written on them. The teacher or one of the children then calls out words randomly or gives the definition of each word, and the students see how quickly they can complete their Bingo cards.

b. In learning spelling words, teachers focused on activities such as word searches and crossword puzzles as ways to get experience with the words. Teachers often emphasized the rules illustrated by words on the spelling list (e.g., several words on the list may demonstrate the "f" sound produced by the letters "ph" to help children identify regularities in spelling that they can use later in attempting to spell new words.

c. In math, teachers at these grade levels still may be helping children to master their math facts. Activities to give children practice with their facts and to motivate them to learn this material include various games. One teacher described a "mad minute" game in which the child is given exactly 60 seconds to answer as many multiplication problems as he or she can. The child works through a page of problems and receives one point for each item completed correctly. Over time, the child can keep track of how well he or she has done and can see improvement from week to week. Another teacher gives such tests regularly until the child is able to complete a specified number of problems in one minute; after the child has mastered this task, no more such tests are necessary.

A teacher reported that a parent had invented an unusual method of helping a child learn math facts. The parent took flashcards and put them up at various places in the house (on the refrigerator, on doors). Whenever the child went to the refrigerator, then, he had to say the answer to the flashcard before opening the door. The parent changed the cards regularly, and by the end of the year, the child had mastered his math facts.

4. In order to promote learning that is context-free, the teachers described several procedures:

A teacher reported that she wanted children to learn to use their spelling words in a variety of contexts rather than just learning to write the list for the test. She encouraged this not only through varied weekly activities but also by giving different kinds of spelling tests each week. Sometimes children were asked to figure out the word from scrambled letters, or they might be asked to fill in missing letters in a word, to fill in the correct word in a sentence, or to take a traditional test. Such varied tests allowed the teacher to assess the child's knowledge of the meaning and use of the word as well as his or her knowledge of a correct letter sequence.

A teacher noted that in math, children would get "hints" about what operation to use in word problems from the context of the lesson: If the lesson had been on multiplication, then the word problems would probably require that same operation. In order to avoid children's relying on such cues, she tried to vary the nature of the word problems, so that several different operations would be required in each set of problems. In learning maps, a teacher noted that children had difficulty generalizing from the type of map on which they learned to new, different-sized, or differently oriented maps.

In order to teach such generalization, the teacher can first, see that the child has learned locations on one map, and then specifically give experience in transferring information from that familiar map to a new one. It cannot be assumed that things learned in one setting will automatically be generalized to a new and different setting.

One parent told the teacher that she would give the child review questions, spelling words, or math fact questions while the child was watching TV or just hanging around at home, to give the child practice in thinking about school work outside of his usual learning context.

5. Finally, in order to promote long-term retention of information, teachers found ways to encourage children's repeated involvement with the material. In math, teachers mentioned moving from one topic to another and then coming back again to make sure that the student would retain a skill once learned. This is particularly important for a complex skill such as long division, where there are several steps that must be carried out in the correct order.

In spelling, teachers described various ways to help children retain words learned in earlier lessons. Some teachers gave unit tests that drew from whole sections of the spelling book, or selected words from previous lessons to add to the regular list for the week. Some teachers carried over words from one week to the next until the child could spell them correctly for several consecutive weeks. Another teacher asked children to put incorrect words into a personal dictionary, so that when they needed to use these words in a writing assignment, they could easily check the spelling.

In summary, we found that teachers at each developmental level were able to aid their students' strategy use for effective memory, and also to encourage development of children's knowledge and awareness of memory processes. Research has shown that it is possible to teach children to use their memory skills more effectively. Teachers have the opportunity to do such teaching on a day by day basis, in the context of regular lessons. We encourage teachers to try out the suggestions given here and also to create new learning activities for their classrooms on the basis of the principles we presented here.

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Chapter 6. Summary, Conclusions, and Dissemination Plans

This research originated with an interest in how the elementary school experience influences the development of memory abilities, including strategy use, memory knowledge, and self-regulation of learning efforts. Although there is an extensive literature on memory development and the training of memory skills in young children in laboratory settings, developmental psychologists have had until now little information about how teachers encourage or stimulate memory efforts in the classroom. One aspect of the present work (Chapter 2) attempted to describe ways in which teachers help children master learning and memory tasks and how their activities vary with grade level and subject matter. In the latter part of Chapter 2, we presented findings concerning teachers' views of children's skills in the areas of memory knowledge, monitoring of memory activities, and generation of memory strategies. Finally, we were interested in determining how teachers' variations in the ways in which they attempt to instruct memory and cognitive activities in the classroom affect the memory activities of children in their classes. The study reported in Chapter 3 was an initial effort to answer this question.

From the standpoint of education, the study yields important information about what teachers actually do in the classroom to aid children's memory. The classification of memory strategy suggestions created as part of the work described in Chapter 2 can be used to help teachers find new ways to facilitate children's learning, either by using examples observed in the research or by generating their own procedures on the basis of principles involved in definitions of the several categories. Teachers need to know that there are specific memory strategies that they can use other than simple rote activities. Although the education literature has begun to adopt a cognitive developmental perspective in some research and in textbook recommendations for teachers-in-training (Biehler & Snowman, 1982; Davis, 1983; Woolfolk & McCune-Nicolich, 1984), only minimal suggestions are usually made about kinds of strategies that may be effective and about how metamemory knowledge and self-regulatory activities can be encouraged by teachers.

Major findings of the present research may be summarized as follows:

Teachers of grades K through 6 give their children suggestions about preferred techniques for processing information, including recommendations for strategy use in dealing with mathematics and language arts lessons.

The tendency to suggest strategies and other cognitive processing activities, to suppress strategy use, to give

rationales for strategy use, and to request children's questions about schoolwork are activities that load on a single factor, suggesting individual differences among teachers in the tendency to be oriented toward cognitive processing activities in their teaching, differences that are not simply a function of amount of teacher activity in the classroom.

A number of differences are seen across grade level in the nature of teachers' study suggestions, all of which seem to be appropriate applications of a developmental perspective: First, teachers of children in grades 2-3 most often made strategy suggestions, reflecting some awareness of the potential for memory strategy training at these grade levels. Second, suggested functions of external aids in regulating attention or problem-solving were developmentally appropriate. Third, teachers were increasingly likely over grade level to accompany strategy suggestions with a rationale for strategy use, showing some awareness of children's increasing metacognitive skill over the elementary school years.

Teachers' suggestions varied appropriately with subject matter, as well. First, more suggestions for cognitive processes and strategy use were made by teachers observed during mathematics and language arts instruction than by those observed during only language arts classes, apparently reflecting teachers' efforts to help children think through the conceptualization procedures required in mathematical performance. Secondly, instruction in mathematics more often involved the use of strategies that would help the child assimilate or represent a new mathematical concept, while instruction in language arts more often involved suggestions for activities that would help the child analyze text or reading workbook exercises.

Although teachers vary their suggestions to fit the grade level and subject matter of the classroom, some limitations on their suggestions were also noted. The relatively brief, nonspecific comments often made about how children should study may reflect teachers overestimates of children's abilities to carry out memory activities and to conceptualize memory phenomena. Greater emphasis on metacognitive information, both in providing rationales and feedback about strategy use and in encouraging children's awareness of memory processes, would be desirable in helping children acquire eventual self-sufficiency in their study.

Teachers expected differences in many aspects of memory performance and understanding as a function of children's classroom achievement level. Higher achievers are seen as more competent in most aspects of memory.

Differences in expectations by teachers of different grade levels are seen in judgments of memory strategy use and some aspects of memory knowledge. Less difference by grade level is shown for less immediately observable characteristics, those having to do with metamemory and monitoring and control activities.

In relation to developmental changes in memory knowledge and monitoring and control processes described in the literature, it appears that teachers at the earlier grades (especially kindergarten and first grade) expect more mature and sophisticated memory skills than their children are likely to demonstrate.

Children of moderate and low achievement levels are affected by variations in the extent to which their teachers make cognitive and strategy suggestions during classroom instruction. Among these children, those whose teachers are high in strategy suggestions are better able to maintain use of a trained memory strategy and to show metacognitive understanding of the strategy.

Through presentation of information on memory development, training principles, and teachers' use of memory strategy suggestions in the classroom, it is possible to help teachers gain more accurate views of the development of memory phenomena, and (according to their self-reports) to increase their use of memory strategy suggestions in the classroom.

We conclude from this research that teachers have a great deal of information to share with each other concerning the facilitation of memory development. Our workshop has been one effort to formalize this communication. Although teachers use memory strategy suggestions, often in very appropriate ways, there are still aspects of this subject matter in which teacher education can be improved. We see this project as an initial effort to help teachers gain a cognitive developmental perspective that includes an awareness of memory and metacognitive phenomena, as well as specific techniques to use in their classrooms.

We are involved currently in efforts to disseminate the findings of this research so that teachers may learn more about memory. We have presented four papers on the work at national conventions (Hart, Leal, Burney, & Santulli, 1985; Leal, Burney, & Johnson, 1985; Moely, Leal, Pechman, Shelley, Santulli, Burney, Baron, & Piazza, 1984; Moely, Santulli, & Rao, 1985). Another paper has been submitted for convention presentation, and plans are underway for additional presentations at regional or national meetings during 1986.

We have distributed copies of the workshop narrative (Chapter 5) to the 14 schools involved in the research, to parish school offices, and to each of the teachers who took part in the research. We have given the workshop to an education class at Tulane University and to teachers and administrators from a number of elementary schools in the New Orleans area. We plan to use the videotape of the workshop presentation and the written materials in courses for undergraduates and graduate students in Psychology and Education at Tulane University and several other universities. Parents of the children who participated in the second study have been informed in a general way of the findings of the research, in a letter mailed to them at the completion of the project. Efforts are underway now to prepare articles for journal publication, in which we will present the findings of the research and describe its implications for developmental psychology and elementary education.

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